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ABSTRACT

Seven papers review research in speech-language pathology and audiology. K. Polzer et al. describe an investigation of sign language therapy for the severely language impaired. S. Dworetsky and L. Clark analyze the phonemic and nonphonemic error patterns in five nonverbal and five verbal oral apraxic adults. The performance of three language impaired children is compared on tone identification and tone sequencing tasks by P. Barone and D. Thal. C. Royster-Branker and D. Bernstein evaluate two language disordered children and their comprehension of indirect directives. A paper by I. Paderewski and M. Mazor uses the acoustic reflex thresholds for pure tones and white noise to predict the degree of hearing loss in eight children with sensoryneural loss. H. Lasky and R. Rosenbaum investigate the development of conversational skills in a language impaired child through television modeling. Imitation vs. comprehension training is the subject of a final study by S. Paluszek and F. Kasten Feintuch. (CL)

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WORKING PAPERS IN EXPERIMENTAL SPEECH-LANGUAGE PATHOLOGY AND AUDIOLOGY

Speech and Hearing Center
Department of Communication Arts and Sciences
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August 1979

The investment in research by graduate students and faculty is fundamental to competent education and training at a University. Having implemented this experimental approach at our Center almost ten years ago, it has been very rewarding for us to observe the increased interest in clinical research in speech-language pathology and audiology.

The papers in this eighth volume continue to translate theory into practice and examine some insights about the clinical process. We hope that our colleagues find them useful.

Robert Rosenbaum
Joel Stark

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The acquisition of arbitrary and iconic signs: imitation vs. comprehension

Kathleen R. Polzer
Lorain L. Wankoff*
Sima Gerber Wollner*

Abstract

This study examines two issues concerning sign language therapy for the severely language impaired: which signs should be selected for training and what strategy or strategies should the clinician employ to facilitate acquisition of the signs and generalization to novel stimuli. The effects of imitation and comprehension training during the acquisition of iconic and arbitrary signs were investigated. The relationships between sign categories, method of training, generalization to less prototypical instances and over-generalization to non-trained stimuli were explored. The results indicated that training of iconic signs through imitation best facilitated correct production of trained stimuli, generalization items and over-generalization items.

The origins of sign language lie in the needs of the deaf to communicate. American Sign Language (ASL) is the most widely used manual system in the United States today. ASL or Ameslan was developed in France by de l'Épeé in the eighteenth century and was brought to America by Gallaudet in the nineteenth century. Recently, systems have been developed to more closely approximate the English language. For example, Seeing Essential English (SEE), Linguistics of Visual English (LVE) and Signing Exact English and Signed English are based on ASL and English. Because of common usage and wide acceptance ASL has been employed, for the most part, in studies on sign language.

Bornstein (1973) stresses that "the principal purpose of any language is to communicate concepts or ideas" (p. 454). The issue of whether sign language represents a true language has been addressed by Cutting and Kavanagh (1975), Wilbur (1976), Mayberry (1976), Bellugi and Klima (1972), Bellugi and Fischer (1972), Bornstein (1973) and Moore (1974). "Manual sign language employed by deaf individuals do indeed constitute legitimate language systems" (Moore, 1974, p.377). Wilbur (1976) believes that "ASL does in fact function as a complete language and fully meets the communicative needs of the deaf among themselves as a linguistic and sociologic community" (p.433). Like other languages it is composed of a syntax, semantics, morphology and phonology. While some signs are iconic (resemble meaning), most are arbitrary (do not resemble meaning).

According to Bellugi and Klima (1972) sign language does not simply parallel or derive from spoken English. Sign has no phones; instead, the important aspects of a sign are the hand configuration, the space in which the sign is executed, the place of articulation in

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relation to the body of the signer and the movement of the hands (Cutting and Kavanagh 1975, Mayberry 1976, Bellugi and Klima 1972, Dale 1976, Wilbur 1976).

According to Bloom and Lahey (1978) alternative systems of language must be considered for children for whom intelligible speech appears virtually impossible. "Speech and language pathologists have shown an increased interest in sign language as an alternative means to establishing communication in normally hearing clients for whom all speech and language habilitation attempts have failed" (Mayberry, 1976, p.223). Konstantareas, Oxman and Webster (1977) emphasize the failure of efforts to develop speech with severely dysfunctional, non-verbal children, despite operant conditioning methods. "Alternatives to speech training are badly needed if these children are to enjoy some semblance of human interaction and discourse" (p.269). The authors suggest simultaneous communication (gestures paired with speech) as such an alternative.

Training studies using sign language with language impaired hearing children include a study by Shaffer and Goehl (1974), in which the authors defined the "alinguistic child" as "one who shows no language or functional communication" (p.3). Children who fall into this category "do not speak, have not responded to language therapies, and behave as if they are cognitively incompetent" (p.3). The authors believe that such children possess greater potential than exhibited. For unknown reasons, they are incapable of using the auditory signals of speech. "Their capacity to acquire language may be intact but they are prevented from learning because of a defective auditory system" (Shaffer and Goehl, 1974, p.4). Based on such a premise, and the belief that signs are more "static" than speech, Shaffer and Goehl (1974) have developed a program consisting of gross gestures, signing, fingerspelling and writing to facilitate the individual development of functional communication.

Success in using signs with normally hearing nonverbal low functioning individuals has been reported in recent years by many investigators (Webster, McPherson, Sloman, Evans and Kuchar 1973, Moore 1974, Shaffer and Goehl 1974, Kopchick, Rombach and Smilowitz 1975, Topper 1975, Kopchick and Lloyd 1976, Konstantareas and Leibowitz 1977, Konstantareas, Oxman and Webscer 1977, Bonvillian and Nelson 1978, Bricker 1978, Konstantareas, Oxman and Webster 1978, Miller and Miller 1978). Yet, many questions regarding implementation of training, selection of signs and selection of clients remain unanswered.

With regard to methodology, Mayberry (1976) presents three major techniques for teaching signs. "Molding" involves placing the referent in the client's hands to achieve the required handshape (e.g. ball). This is useful when the sign resembles the shape of the object it denotes. "Shaping" involves manipulation of the client's hands to achieve the correct configuration and movement. "Imitation" involves the client copying a model provided by the clinician.

Regarding signs to be taught, Mayberry (1976) suggests beginning with simple, single signs (one word utterances) for objects or actions which would prove useful to the client and bear a physical resemblance to the concepts they denote; that is, occuring daily in his or her environment and are easily produced by the language disordered child.

Autistic, mentally retarded and cerebral palsied clients with reasonable social and motor skills who have not developed an effective means of communication with oral language can be considered as candidates for sign language training. Moore (1974) suggests that introduction of manual communication may prove useful with retarded children and adults.

Despite the guidelines regarding signed language, there is little information on which clients derive benefit from signed instruction as well as the most efficient means of teaching signs to facilitate the development of "maximum communication ability" (Topper, 1975, p.30).

In reference to signs chosen and procedures employed for training, Bricker (1978) investigated the "development of initial word meaning by young low-functioning children" (p.381), based on the premise that naming objects in the environment signals the development of meaning. In a previous experiment, the author had failed to teach children to label using a word-object association paradigm. Therefore, imitated signs, signs paired with words and signs paired with objects served as the discriminative stimuli for labelling in a two way discrimination task. Bricker (1978) concluded that "the experimental training procedure operated as a facilitator for the development of word-object association with this particular group" (p.389) of severely retarded children. Modelling and shaping procedures were used throughout to facilitate appropriate emission of the signs.

A number of single organism studies have introduced signs to children difficult to reach with conventional methods. Topper (1975), for example, chose signs which closely resembled referents and represented functional concepts. The training procedures included imitation and simultaneous communication. A fifty word sign vocabulary was mastered by the subject (a twenty eight year old severely retarded institutionalized male). The acquired language established a useful form of communication and decreased the subject's frustration.

Bonvillian and Nelson (1978) taught ASL to a nine year old autistic boy who had failed to develop speech. The subject's visual and motor skills appeared to be intact and the experimenters found they could readily mold the subject's hand movements. The authors chose signs for which there was an observable relationship between the sign and its referent (e.g. drink). Both molding and imitation were incorporated into the training procedure. After six months of daily one-half hour sessions, the subject spontaneously produced over

fifty signs, singly and in combinations. He also generalized the signs to new situations.

Kopchick, Rombach and Smilowitz (1975) and Kopchick and Lloyd (1976) undertook projects which took into account the problem of environmental control encountered by other researchers. "Control of the environment is a major factor in making sign language useful" (Kopchick, et al, 1975, p.23). Subjects in both studies consisted of institutionalized adults surrounded with staff trained in sign who rewarded attempts at communication rather than passivity. "This constant use of simultaneous communications provides a model for clients who observe the communication interaction, and it demonstrates to them that this interaction is a productive functional tool that causes environmental change" (Kopchick and Lloyd, 1976, p.511). Imitation, successive approximation, one-to-one personal contact between staff and subjects, and tangible reinforcers proved useful. "They (the subjects) learned that it was easier to manipulate people through specific and structured gestures than to scream and pound tables" (Kopchick and Lloyd, 1976, p.517).

Konstantareas and Leibowitz (1977) believed that the success of simultaneous communication training with the nonverbal was a direct result of the mode of representation. In their study, visual training (signs only) was compared with auditory-visual training (simultaneous use of signs and words). The simultaneous or auditory-visual mode of representation proved to be a more effective method of training both receptive and expressive skills. In addition, the researchers concluded that difficult to produce signs were less easily acquired, signs which represented nouns were more easily acquired and receptive skills were superior to expressive use of signs.

In a similar study, Konstantareas, Oxman and Webster (1978) reported that nonverbal children found iconic signs easier to learn than non-iconic signs. The authors defined iconicity as "the degree of physical similarity between a sign and its referent, in conjunction with the extent to which a sign offers the perceiver a clue to meaning" (p.224). The signs were trained in receptive and productive tasks. The authors suggests that "with continued research of this kind...we might hope to further clarify...the intricate process" (p.234) of sign language acquisition.

Several researchers studying the acquisition of ASL have concluded that children who learn sign as a first language (that is, deaf children of deaf parents) express the same semantic relations and exhibit similar increases in MLU (mean length of utterence) and instances of over-generalization as hearing children acquiring oral language (Dale 1976, Bellugi and Klima 1972). Further, they noted that "just as the first words are not pronounced exactly like those of adults, the first signs are not perfect reproductions of adult models" (Dale, 1976, p.58).

Parallels have been found for the acquisition of sign language during training and normal language acquisition. After sign training,

Bonvillian and Nelson (1978) found that an analysis of their subject's two sign combinations revealed the presence of the same semantic relations found in the speech of normal children learning spoken language (e.g. recurrence - "more milk"; negation - "no food").

Konstantareas, Oxman and Webster (1977) also found parallels between the acquisition of sign language by dysfunctional children and spoken language by normals. Four of their five subjects developed a receptive and, to a lesser extent, expressive knowledge of the signs trained. Also, the signs were used as normals used one word utterances, that is, "in a very context specific fashion to denote different meaning, e.g. ball may mean 'this is a ball,' 'throw a ball to me,' or 'I want to play with the ball.'" (p.277).

In teaching signs to hearing adults, deaf signers are frequently aware of and focus on iconic signs. "Handbooks of signs often contain information on how to form the signs, and then specify some representational aspect of signs" (Bellugi and Klima, 1976, p.524). It has been suggested that in beginning to teach signs to nonverbal language delayed children certain criteria should remain constant: signs should represent functional concepts for the individual child, useful in his or her environment; signs should be easy to produce, consisting of simple movements and handshapes; and the verbal label to be paired with the signs should be short words, and easy to imitate.

Traditionally, the selection of intervention methods has been influenced by the knowledge of how the normal child acquires language. A number of researchers have examined the roles of imitation versus comprehension in language acquisition (Dale 1976) and in training procedures of spoken language forms (Rees 1975, Bloom and Lahey 1978). However, controversy exists regarding the role of imitation and comprehension in language acquisition (Dale 1976). While the use of imitation is standard clinical practice (Rees 1975) "there has been no consensus in the literature as to whether imitation is important or, if imitation is important, in what ways imitation contributes to language learning" (Bloom and Lahey, 1978, p.272). Many language theorists believe that imitation plays a minor role in language acquisition by normal children.

Nevertheless, "many studies and language programs have stressed the imitative production of linguistic forms as a first step in language learning" (Bloom and Lahey, 1978, p.564-565). The knowledge that imitation may not play a role in language development of normal children should not deter the speech clinician from investigating its value in therapy. "Children are referred to the therapist precisely when the normal process of development has failed. The use of imitation must be evaluated in each appropriate context" (Dale, 1976, p.111).

The extent to which a clinician uses imitation as a therapeutic tool depends on the clinician's orientation to intervention and the goals established for the client (Rees 1975). Clinicians who believe that the language-disordered child has been deprived of sufficient

input and stimulation and view the goal of therapy as the development of rule governed behavior will de-emphasize the use of imitation. Conversely, clinicians who believe the language-disordered child to be deviant and not just delayed may establish imitation as a training strategy. The issue of whether such children are delayed or deviant, however, is far from resolved. Indeed, such clear dichotomies seldom exist in reality.

Bloom and Lahey (1978) believe that while studies have shown imitation to be an effective training tool in the context of therapy, "the extent of establishment beyond the original training situation is not clear, because it has rarely been studied" (p.559). In other words, carry-over or generalization, a vital and terminal goal of therapy, has not been successfully demonstrated using imitation.

Lenneberg (1967) in fact, believes that it is possible to learn language without overt imitation. For example, there are people who cannot speak because of paralysis of the speech musculature, but nonetheless, do demonstrate an understanding of speech. A second alternative, then, to facilitate language development involves the use of comprehension tasks.

Some theorists "recommend extensive training in comprehension before training or even encouraging production of forms" (Bloom and Lahey, 1978, p.565). Literature on normal child language acquisition has always inferred that children are almost always capable of responding to more language than they can produce themselves. In 1974 Ingram proposed that "comprehension ahead of production is a linguistic universal of acquisition" (p.313).

As Bloom and Lahey (1978) note "speech recognition is often reported to precede speech production" (p.240). However, the words children first produce are not necessarily those words for which they have demonstrated an understanding. "Language learning no doubt depends on the relationship between the speech children hear and what they see and do" (Bloom and Lahey, 1978, p.241).

Hoffman and Wollner (1977) investigated the efficacy of imitation and comprehension procedures on the acquisition of third person subject-verb agreement. Their results "indicated that comprehension training best facilitated the acquisition of a syntactic rule as measured by advances in comprehension, production, grammaticality judgement, and grammaticality correction. Although the subject performed well during imitation training, testing in other linguistic performances revealed that learning of the rule trained with this procedure had not taken place" (p.13).

Ruder, Smith and Hermann (1974) studied the effects of imitation and comprehension training on verbal production. The authors investigated the claim by some researchers that comprehension training alone is sufficient to facilitate use or production. Based on data from two normal children and one language delayed child they concluded that

"some combination of both verbal (imitation) and comprehension training seems to be a necessary prerequisite to achieving verbal production" (p.26) of lexical items.

The present study was designed to examine two issues appearing in the previous research. Firstly, in training functional signs, iconic and non-iconic, simple and paired with the appropriate verbal labels, which will be more easily acquired? Secondly, should signs be trained through imitation or comprehension in order to facilitate the production and generalization to novel stimuli?

Method

Subject:

J was a 16.10 year old male currently enrolled in his fourth semester of speech and language therapy at the Queens College Speech and Hearing Center. J's parents reported that the developmental milestones were delayed: sitting unassisted six months, walking two years, toilet training completed five years, speech at seven years. J's parents felt he had acquired "very little speech;" primarily using gestures to make himself understood.

A battery of tests were administered over time to assess appropriate educational placement. A psychological evaluation revealed J to be an "organically impaired youngster who is functioning as a severe to low moderate retardate."

A series of language based tests were administered when the subject was 15.11 years old. The following results were obtained: ACLC; 80% correct responses on two and three critical elements, 50% correct responses on four critical elements; Peabody Picture Vocabulary Test, form B; vocabulary recognition age of 4.9 years; Fisher-Logeman Test of Articulation Competence; an undifferentiated pattern of articulation errors and the psycholinguistic age scores on the Illinois Test of Psycholinguistic Abilities; Visual Reception 4.4 years, Visual Sequential Memory, 4.10 years, Visual Association, 2.6 years, and Manual Expression, 6.1 years.

The subject was enrolled in speech and language therapy at Queens College Speech and Hearing Center. At the onset of this study, J's sign repertoire consisted of the following: cookie, pretzel, drink, eat, milk, thank you, man, girl, give me, I, want, my, light, ball, more, yes, no, throw, work, up, you're welcome.

Apparatus:

The experimental procedure was conducted in a twelve by fifteen foot room. The subject and the experimenter were seated directly opposite each other at a desk. An observer was present to record the data. A token schedule of reinforcement was employed.

Stimulus materials consisted of one hundred 4 x 6 inch plates. Each plate contained a 3½ x 5 inch photograph*. The plates were categorized according to their prototypicality. Prototypicality was defined as the extent to which a stimulus had attributes overlapping other members of the same category. Prototypicality of a referent and its less prototypical counterparts, as well as overgeneralization and non-trained stimulus alternative objects, were determined independently by each of the three authors. Ratings were compiled and agreement noted. Twenty plates were selected which depicted the most prototypical referents of the signs. Forty plates containing less prototypical referents were used to test for generalization of the trained response. Twenty plates contained pictures used to test for overgeneralization of the trained responses (e.g., "cat" for "dog"). An additional twenty plates depicted a stimulus alternative to be used in the initial two way discrimination tasks. The pictures represented objects related in function to the target sign (e.g., sign trained was "toothbrush", non-trained stimulus alternative paired with toothbrush was "soap").

Twenty signs were chosen from The Preschool Dictionary for Preschool and Elementary Levels (1975). Ten signs were iconic and ten were arbitrary. Iconicity ratings were determined by administering a multiple choice test to normal adult subjects. All signs chosen represented nouns which would prove useful to the subject.

Table I

Signs Trained

Imitation	Comprehension
Iconic	Arbitrary
toothbrush	store
pencil	school
pants	pajamas
baby	lady
coat	shoe
Arbitrary	Iconic
stove	radio
car	telephone
sock	shirt
dog	fish
boot	hat

* The authors wish to express their appreciation to the photographer, Jeffrey Polzer.

Ease of articulation production was also considered in the selection of signs.

Procedure:

Fifty five undergraduates at Queens College, Department of Communication Arts and Sciences, served as subjects in a pre-test. The purpose of the pre-test was to rate signs as either iconic or arbitrary. The following definitions were used for making judgements. "An iconic sign is any sign which is similar in some respect to that which it denotes" (Barnlund, 1968, p.36). An arbitrary sign is one for which there is no such observable relationship between the sign and its referent.

Any student familiar with sign language was eliminated from participation in the pre-test. The undergraduates were then presented the following task: a multiple choice test was designed in which one of the experimenters modelled twenty eight signs in succession. Each sign was preceded by the question, "What does this look like?" The subjects were required to choose one of four answers (e.g., experimenter modelled the sign for "apple", the choices given were: A. apple, B. piano, C. earrings, D. teacher). Standard frequency index for all words used in the test was $\leq 69.9 \geq 42$ (as measured by The American Heritage Word Frequency Book, 1971).

As a result of the test, twenty functional and simple to perform signs were chosen for training. "Percent right" on an item analysis of the data determined the selection of ten iconic and ten arbitrary signs. (Iconic signs chosen were 93-100% correct; Arbitrary signs were 15-67% correct).

Performance on three tasks was investigated (Imitation, Comprehension and Production). Imitation and Comprehension were used as training procedures. Performance on all three tasks was measured prior to and after training.

For the purpose of this study the three tasks were defined as follows:

Task #1 Imitation of a sign was defined as a response that could be characterized as a duplicate or copy of the model's behavior. Parameters included the hand configuration, the space in which the sign was made, the direction of movement and the place of articulation in relation to the body of the signer.

Task #2 Comprehension of a sign's meaning was defined as the ability to point to an appropriate picture depicting the sign's referent in one and two way discrimination tasks.

Task #3 Production was defined as the ability to use a sign when presented with training stimuli, generalization stimuli and over-generalization stimuli after the completion of training.

Pre-training baselines: Baselines for Imitation (I), Comprehension (C) and Production (P) were administered on four successive sessions prior to training. Each baseline was preceded by a training task in which J was presented with photographs of a "ball" and/or "cookie" and asked to imitate, produce or demonstrate comprehension of the appropriate signs. The signs for "cookie" and "ball" were previously trained.

Imitation, Comprehension and Production tasks were presented in the following order:

1) Production[1] for training stimuli for the signs toothbrush, stove, pencil, car, pants, store, radio, school, telephone and pajamas. S^D= "J, what's this?" Order of presentation of stimuli was randomized. Each stimulus was presented twice.

2) Production[2] for the over-generalization stimuli for the signs toothbrush, stove, pencil, car, pants, store, radio, telephone, school and pajamas. S^D= "J, what's this?" Order of presentation of stimuli was randomized. Each stimulus was presented twice.

3) Comprehension[1] using the training stimuli and non-trained stimulus alternatives in a two way discrimination task. S^D= "J, show me sign+verbal label." Order of presentation of stimuli was randomized. Each stimulus was presented twice for the signs toothbrush, stove, pencil, car, pants, store, radio, telephone, school and pajamas.

4) Comprehension[2] using the training stimuli and non-trained stimulus alternatives in a two way discrimination task. S^D= "J, show me sign." Order of presentation of stimuli was randomized. Each stimulus was presented twice for the signs sock, baby, dog, coat, boot, shirt, lady, fish, shoe and hat.

5) Production[2] for the over-generalization stimuli for the signs sock, baby, dog, coat, boot, shirt, lady, fish, shoe and hat. S^D= "J, what's this?" Order of presentation of stimuli was randomized. Each stimulus was presented twice.

6) Production[1] for the training stimuli for the signs sock, baby, dog, coat, boot, shirt, lady, fish, shoe and hat. S^D= "J, what's this?" Order of presentation of stimuli was randomized. Each stimulus was presented twice.

7) Comprehension[2] using the training stimuli and non-trained stimulus alternatives in a two way discrimination task. S^D= "J, show me sign." Order of presentation of stimuli was randomized. Each stimulus was presented twice for the signs toothbrush, stove, pencil, car, pants, store, radio, telephone, school and pajamas.

8) Production[3] for the less prototypical referents for the signs toothbrush, stove, pencil, car, pants, store, radio, telephone, school and pajamas. S^D= "J, what's this?" Order of presentation of stimuli was randomized. Each stimulus was presented twice.

9) Comprehension^3 for the less prototypical referents for the signs sock, baby, dog, coat, boot, shirt, lady, fish, shoe and hat. Each stimulus was arbitrarily paired with another stimulus. Order of presentation was randomized. Each stimulus was presented twice. S^D= "J, show me sign+verbal label."

10) Comprehension^2 using the training stimuli and non-trained stimulus alternatives in a two way discrimination task. S^D= "J, show me sign." Order of presentation of stimuli was randomized. Each stimulus was presented twice for the signs sock, baby, dog, coat, boot, shirt, lady, fish, shoe and hat.

11) Comprehension^3 for the less prototypical referents for the signs toothbrush, stove, pencil, car, pants, store, radio, school, telephone and pajamas. Each stimulus was arbitrarily paired with another stimulus. Order of presentation was randomized. Each stimulus was presented twice. S^D= "J, show me sign+verbal label."

12) Production^3 for the less prototypical referents for the signs sock, baby, dog, coat, boot, shirt, lady, fish, shoe and hat. S^D= "J, what's this?" Order of presentation of stimuli was randomized. Each stimulus was presented twice.

13) Imitation of all signs to be trained in the presence of the most prototypical pictures (training stimuli) of the referents. S^D= "J, do what I do." Order of presentation was randomized. Each stimulus was presented twice.

Imitation and Comprehension training were counterbalanced across sessions. Each sign was presented until criterion of three correct responses was achieved (number of presentations varied as a function of the level of training). The signs toothbrush, stove, pencil, car, pants, store, radio, school, telephone, and pajamas were trained (five through imitation, five through comprehension) followed by the training of sock, baby, dog, coat, boot, shirt, lady, fish, shoe and hat. Order of presentation of signs within a session was randomized.

Procedure I consisted of imitation training of five iconic signs (toothbrush, pencil, pants, baby, coat) and five arbitrary signs (stove, car, sock, dog, boot). Imitation training was developed on the following three levels:

On Level A a one-way discrimination task was presented to the subject. For each sign trained, the corresponding picture was placed on the table before the subject. The experimenter presented the S^D "J, look, do sign+verbal label" and performed the sign. J was required to look at the stimulus picture and imitate the sign. All signs produced in this initial level were shaped. Training at Level A was carried out for two consecutive therapy days. The number of trials per day was held constant at forty-five with five signs trained per day. Each of the five signs was presented in a random order, modelled and the response shaped for three consecutive trials. The

order was randomized and the process repeated two times. (For example, signs toothbrush, pencil, pants, baby and coat were presented three times each; the order of presentation was then changed, signs presented and the order of presentation changed once again for a total of forty-five trials per day.)

On Level B a two-way discrimination task was presented to the subject. For each sign trained, the appropriate picture and a non-trained stimulus alternative were placed on the table before the subject. The picture representing the target sign was placed closer to the subject, to serve as a prompt. The experimenter presented the S^D "J, look, do sign+verbal label" and modelled the sign. Five signs were modelled per session and presented in a random order. Total number of imitation trials per session for Level B (excluding corrections) was held constant at sixty. Each sign was modelled and the correct response required in three consecutive trials. The first of the three trials was shaped, the remaining two were not. The process was then repeated twice, changing the order of presentation of the signs for a total of sixty trials.

If the subject failed to reach criterion (three correct consecutive responses) a correction procedure was implemented. The verbal "no" was followed by the correct model of the desired response. The experimenter then returned to Level A, presented the sign and shaped the correct response three times, followed by a return to Level B. If the subject failed to reach criterion a second time, Level A was again presented and followed by the representation of the task at Level B. If the criterion was not achieved on a third attempt, the sign was discontinued and the next sign introduced.

On Level C a two-way discrimination task was presented to J. For each sign trained, two pictures were placed at equal distance before the subject (one representing the target sign, the other representing another experimental sign in the same category. For example, "sock" and "pants"). The experimenter presented the S^D "J, look, do sign+verbal label." Each of the five signs was again presented for three consecutive trials. For the first trial, the experimenter shaped the subject's response. The next two trials were unprompted. This procedure was repeated once for a total of thirty trials per day at Level C.

If the subject failed the reach criterion the following correction procedure was employed: the experimenter returned to Level A and the subject was required to reach criterion of three consecutive correct shaped responses. Level B was then implemented and was followed by a return to Level C. If he again failed to reach criterion, the correction procedure was repeated once. Training at each level lasted two days.

Procedure II consisted of comprehension training of five iconic signs (radio, telephone, shirt, fish, hat) and five arbitrary signs (store, school, pajamas, lady, shoe). Comprehension training involved three levels, corresponding to the imitation training.

On Level A, for each sign trained, the corresponding appropriate

picture was presented to the subject. The experimenter presented the S^D "J, look, show me sign+verbal label." All responses at this level were shaped. J was required to point to the stimulus picture with the experimenter. The subject was required to respond correctly on three consecutive trials before the next sign was introduced. Number of trials per day was held constant at forty-five. Five signs were trained per day in this comprehension task. Each of the five signs was presented in a random order, and the response prompted, for three consecutive trials. The process was repeated two times, varying the order of presentation of the signs.

On Level B a two-way discrimination task was presented to J. For each sign trained, the appropriate picture and a non-trained stimulus picture were placed on the table before the subject. The picture representing the target sign was placed closer to the subject to serve as a prompt. The experimenter presented the S^D "J, look, show me sign+verbal label." Five signs were presented in a random order. Criterion for advancement to the next sign was correct responding on three consecutive trials. The first of the three trials was prompted by pointing to the correct picture. The next two trials were unprompted. A total of sixty trials was presented per day.

If the subject failed to reach criterion a correction procedure was implemented in which the experimenter returned to Level A, presented the sign and prompted three correct responses after presenting the verbal "no" and a model of the correct response. Following Level A the experimenter proceeded to Level B. The correction procedure was applied a maximum of two consecutive times for each sign.

On Level C a two-way discrimination task in which two pictures were placed equally distant (one picture represented the target response, the other represented another experimental sign in the same category). The experimenter presented the S^D "J, look, show me sign+verbal label." During the first trial the experimenter pointed to the correct picture with the subject. The next two trials were unprompted. The order of presentation of the signs was randomized. The process was repeated once.

If the subject failed to reach criterion of correct responding on three consecutive trials, a correction procedure was instituted. The verbal "no" was followed by a model of the correct response and a return to Level A. The experimenter then progressed to Level C with the subject reaching criterion at each level. The correction procedure was repeated only once at this level. Training at each level encompassed two days.

On post-training baselines, the signs toothbrush, stove, pencil, car, pants, store, radio, school, telephone, and pajamas were trained and followed by the administration of imitation, comprehension and production baselines. Similarly, the signs sock, baby, dog, coat, boot, shirt, lady, fish, shoe and hat were trained and baselines for imitation, comprehension and production administered following the completion of training.

Results

A comparison of pre-training and post-training baselines indicates that correct production of the twenty target signs increased from 0 to 82.5%, 33/40 trials, in the presence of the training stimuli (P^1). While the comprehension training task involved the presentation of the sign paired with the appropriate verbal label, comprehension of the signs only (C^2) increased from 62.5% (25/40) to 92.5% (37/40). Correct imitation of the target signs increased from 45% (18/40) to 87.5% (35/40).

In reference to the ten signs trained through the imitation procedure (five iconic and five arbitrary) a comparison between pre-training and post-training baselines revealed that correct imitation of these signs increased from 40% (8/20) to 95% (19/20) correct. Production of the ten signs, in the presence of the training stimuli (P^1), increased from 0% to 95% correct (19/20). Prior to the training J neither generalized nor over-generalized any of the signs. After training, J over-generalized the production of the signs trained through imitation to different referents (P^2) 30% (6/20). Generalization to less prototypical stimuli in the post-training task (P^3) was 60% (24/40) correct. The signs trained through imitation were generalized more frequently to the least rather than the moderately prototypical instances of the referents (65% or 13/20 vs. 55% or 11/20). J demonstrated 85% (17/20) comprehension (C^2) of the ten signs alone. Pre-training baseline revealed 70% (14/20) comprehension.

Ten signs were trained through a comprehension procedure (five iconic and five arbitrary) and tested after the completion of training. Comprehension of the signs only (C^2) was 100% (20/20) correct post-training as compared to 55% (11/20) pre-training. Production in the presence of the training stimuli (P^1) increased from 0% to 70% (14/20) correct. Over-generalization (P^2) occurred in 30% (6/20) of the trials; generalization (P^3) to new stimuli was demonstrated in 20% (8/40) of the trials post-training. J generalized more frequently to the moderately prototypical rather than the least prototypical instances of the referents trained (20% or 5/20 vs. 15% or 3/20). Imitation of the signs trained through comprehension was 80% (16/20) correct following training.

Following training the iconic signs were produced correctly (P^1) in 95% (19/20) of the trials, as compared to 0% correct production prior to training. Sixty per cent (12/20) were over-generalized (P^2) while 52.5% (21/40) were generalized to less prototypical stimuli. Iconic signs were generalized more frequently to the least rather than the moderately prototypical instances of the referents (50% or 10/20 vs. 55% or 11/20). J demonstrated 95% (19/20) comprehension of the signs alone (C^2). In an imitation task, J correctly imitated, prior to training, 60% (11/20) of the iconic signs. Post-training, J correctly imitated 90% (18/20) of the iconic signs.

In reference to the arbitrary signs trained, in a pre-training production baseline using the training stimuli (P^1) J correctly produced the signs 0%; post-training production for the arbitrary signs was 70%

(14/20) correct. Post-training, 10% (2/20) of the arbitrary signs were over-generalized (P^2) while 27.5% (11/40) were generalized (P^3) to new stimuli. J generalized the arbitrary signs more frequently to the moderately rather than the least prototypical instances of the referents (30% or 6/20 vs. 20% or 5/20). Post-training baselines also revealed comprehension of the signs alone (C^2) was 90% (18/20) correct. Prior to training J correctly imitated 30% (6/20) of the arbitrary signs; post-training J imitated 85% (17/20) of the arbitrary signs.

Further analysis of the data revealed that imitation training facilitated both the imitation of iconic signs (100% correct, 10/10) and arbitrary signs (90% correct, 9/10). Similarly, in the production baseline (P^1) imitation training was shown to facilitate the acquisition of both iconic (90% correct, 9/10) and arbitrary (100% correct, 10/10) signs. Iconic signs trained through imitation were over-generalized (P^2) more frequently than arbitrary signs trained through imitation (40%, 4/10 vs. 20%, 2/10); iconic signs were generalized (P^3) more frequently than arbitrary signs (70%, 7/10 vs. 50%, 5/10). Iconic signs trained through imitation generalized more frequently to the least rather than the moderately prototypical instances of the referents (80%, 8/10 vs. 60%, 6/10). Arbitrary signs generalized with the same frequency to all instances of a category (50%, 5/10 vs. 50%, 5/10). The comprehension of the sign plus the verbal label (C^1) was not differentially affected by the training of iconic and arbitrary signs within the imitation condition, (responses were characterized by 100% correct responding to both categories of signs). In the comprehension of signs only (C^2) our subject showed a greater understanding of the iconic signs trained through imitation (90% correct, 9/10) as compared to the arbitrary signs trained through imitation (80% correct, 8/10).

Table II

Percent correct responses on tasks with iconic and arbitrary signs trained through imitation

Condition	Iconic	Arbitrary
I	100	90
P^1	90	100
P^2	40	20
P^3	70	50
P^3 1	80	50
P^3 2	60	50
C^1	100	100
C^2	90	80

The data also revealed that sign category (iconic vs. arbitrary) did not differentially influence the subject's understanding of the ten signs trained through the comprehension procedure (J scored 100% correct on C^1 and C^2 for the ten signs trained through comprehension). Correct production (P^1) of iconic signs trained through comprehension exceeded arbitrary signs trained through comprehension (100%, 10/10 vs. 40%, 4/10). No arbitrary signs trained through comprehension were over-generalized (0/10) while 60% (6/10) over-generalization (P^2) was noted for the iconic signs trained through comprehension. Similarly, J generalized (P^3) iconic signs in 35% of the trials presented (7/20) and generalized only 5% (1/20) of the arbitrary signs trained through comprehension. Both iconic and arbitrary signs trained through comprehension generalized more frequently to the moderately rather than the least prototypical referents (iconic 40%, 4/10 vs. 30%, 3/10; arbitrary 10% 1/10 vs. 0%, 0/10). For those signs trained through comprehension, imitation of iconic signs exceeded the imitation of arbitrary signs (80%, 8/10 vs. 70%, 7/10).

Table III

Percent correct responses on tasks with iconic and arbitrary signs trained through comprehension

Condition	Iconic	Arbitrary
C^2	100	100
P^1	100	40
P^2	60	0
P^3	35	5
P^3 1	40	10
P^3 2	30	0
I	80	70

Comprehension training of iconic and arbitrary signs facilitated comprehension and imitation training of iconic and arbitrary signs facilitated imitation. That is, our subject imitated the signs trained through imitation more frequently (iconic 100%, arbitrary 90%) than those signs trained through comprehension (iconic 80%, arbitrary 70%), and more frequently demonstrated comprehension of the signs trained through that procedure (iconic 100%, arbitrary 100%) than those signs trained through imitation (iconic 90%, arbitrary 80%).

Imitation training was more effective than comprehension training in facilitating production in the presence of training stimuli as well as generalization to less prototypical referents. However, in the

over-generalization baseline, the training procedure had no differential effect on the subject's performance.

Iconic signs were produced more frequently than arbitrary signs. Iconic signs were also over-generalized more frequently than arbitrary signs.

In addition, a comparison between the conditions revealed that training of iconic and arbitrary signs through imitation and the training of iconic signs through comprehension facilitated production. Comprehension training of arbitrary signs appeared less efficient for facilitating production. Furthermore, iconic signs trained through imitation generalized more frequently to novel stimuli than either arbitrary signs trained through imitation or arbitrary or iconic signs trained through comprehension.

Finally, a comparison of pre- and post-training baselines revealed that percentage of appropriate verbalizations increased in the production baseline (P^1) from 32.5% (13/40) to 60% (24/40) following the training period. Verbalizations for signs trained through imitation exceeded verbalizations for signs trained through comprehension (90%, 18/20 vs. 40%, 8/20).

Discussion

The results of the present study indicated that imitation training best facilitated the acquisition of signs trained as measured by post-training baselines of production and generalization. While comprehension training facilitated a receptive knowledge of the ten signs trained in that condition, the subject failed to produce arbitrary signs as well as generalize both iconic and arbitrary signs trained through comprehension as frequently as signs trained through imitation. It appeared then, that imitation training led to an increased ability to imitate, produce and to a somewhat lesser extent, comprehend signs. That is, production appeared to precede comprehension for signs trained through imitation. This supports the hypothesis by Bloom and Lahey (1978) that production of a form may facilitate learning it. Contrary to the findings of Hoffman and Wollner's (1977) study of verbal language, in this study training through imitation resulted in both the ability to imitate and to use the forms trained with novel stimuli.

Imitation, comprehension, production, generalization and over-generalization of iconic signs generally exceeded that of arbitrary signs. Such evidence supports the findings of Konstantareas, et al (1978) that iconic signs are more easily acquired than arbitrary signs.

The results indicated that J generalized signs more frequently to the moderately prototypical item. While generalization to less prototypical referents is dependent, to some extent, on the number of features they share in common or "the total cue validity of the attributes of items" (Rosch and Mervis, 1975, p.573), generalization also appears to be related to iconicity. J generalized iconic signs more frequently than arbitrary signs to the least prototypical members

of the category.

Prior to the study, the subject demonstrated good comprehension of the trained forms. J lacked, however, an intelligible means by which to express his wants and needs. Our finding that intelligible verbalizations increased as a result of simultaneous communication training lends support to the hypothesis that initial success in sign communication may facilitate the acquisition of spoken language (Dale 1976, Moore 1974).

Dale (1976) describes the acquisition of first signs by deaf children learning sign as a first language. Early sign productions are not exact copies of the adult models. Interestingly, J produced signs modelled by the experimenter, yet, they were not exact copies. It was in these instances that the correction procedure was necessary. Errors on the post-training baselines frequently represented such attempts at sign production.

As a result of this study, J doubled his sign vocabulary. His parents reported that he used a number of the signs spontaneously and appropriately in a variety of contexts. While the procedures were useful to the subject, the authors do not suggest that sign language is the answer for all language impaired children and adults. As Mayberry (1976) stated: "There is no evidence that whatever lies at the root of a language disorder may not also involve the ability to learn sign language" (p.228). Nevertheless, sign language offers an alternative which must be considered for language impaired clients.

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Phonemic and non-phonemic error patterns in non-verbal apraxia and verbal apraxia

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Abstract

The phonemic, and non-phonemic error patterns in five non-verbal oral apraxic adults were analyzed and compared to those of five verbal apraxic adults to determine if differences or similarities between the two groups existed. Responses were elicited by having the subjects repeat after the examiner a random list of 290 combined polysyllabic and monosyllabic words. Taped responses were then transcribed for confusion matrices and feature analysis. Results revealed significantly more similarities in the error patterns between the two groups, however, some relevant differences did occur. Implications for training are discussed.

The purpose of this study was to analyze and compare phonemic and non-phonemic error patterns in a group of adult subjects. Within this group, subjects were differentiated as exhibiting either oral non-verbal apraxia (NVA) or verbal apraxia (VA).

Many previous investigators such as Shankweiler and Harris (1968); Trost and Canter (1974) have not differentiated among non-verbal apraxic and verbal apraxic individuals. Whereas other investigators such as Fry (1959); and LaPointe and Johns (1975) have studied phonological impairments solely in the verbal apraxic. In general, much of the research in this area has been based on a small number of subjects. Furthermore, researchers have only dealt with the phonological impairments, failing to investigate the non-phonemic parameters of these disorders. Therefore, the speech pathologist has not been provided consistent and accurate descriptions of the phonological impairments.

For purposes of the present investigation, verbal apraxia will be defined according to Sands, Freeman and Harris (1978) as "an impairment of the integrative control of the speech production apparatus due to cortical dysfunction." (p.97). The disorder manifests itself as a disturbance in initiation, articulatory transitionalization and selection of articulation gestures (Canter, 1973).

Other investigators (Johns and Darley, 1970; LaPointe and Johns, 1975) describe apraxia of speech as a non-linguistic motor planning disorder without the significant weakness, slowness or in-coordination of the speech musculature. The programming of phoneme production can be selectively impaired without an impairment of language functioning.

Overall results of investigations show the following characteristics to be found in VA. They exhibit 1) a high degree of variability; i.e.

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inconsistent articulation productions from sound to sound, and from word to word; 2) predominantly substitutions; 3) repetitions; 4) disturbed prosody; 5) addition errors; 6) misarticulations more frequently with consonants than with vowel sounds, particularly fricatives, affricatives and clusters are most frequently affected; 7) that position in word has influence upon misarticulations; 8) initiation difficulty, i.e. audible struggles, silent blocks, groping behaviors, undue silent periods.

Oral non-verbal apraxia is defined according to Love and Webb (1977) as "the inability to voluntarily perform non-speech movements with the muscles of the larynx, pharynx, tongue and cheeks, although automatic movements of the same muscles may be preserved." (p.170). DeRenzi (1966) indicated that oral NVA has a significant effect on VA, and thus hypothesized that oral NVA may differ in the degree of severity from VA but that the error patterns will be similar. The relationship of oral non-verbal apraxia to the articulation impairment in aphasia remains unclear.

The present study proposes to determine whether NVA and VA are distinctly different articulatory disturbances or whether NVA is a mirror image of VA but of a more severe nature. For the speech pathologist, this is a necessary question to answer when attempting to devise effective treatment programs.

Method

Subjects:

Subjects consisted of ten adults exhibiting dysfluent phonemic-articulatory impairments of speech resulting from cerebrovascular accident. Five of these adults were diagnosed as exhibiting solely verbal apraxia and five adults as exhibiting non-verbal apraxia. Diagnosis was based upon subjects' medical and speech diagnostic evaluations, and on their ability to perform on specific tasks for brain injured adults as designed by LaPointe and Wertz (1974). These performance tasks included isolating oral movements with and without imitation such as "puff your cheeks," and oral motor sequencing such as "protrude your tongue and bite your lower lip." Non-verbal apraxic subjects were unable to perform over 50% of either of these volitional tasks. Verbal apraxic subjects were able to perform both these volitional tasks. Subjects who displayed oral movement deficits such as weakness, slowness or in-coordination of the speech musculature due to dysarthria (Johns and Darley, 1975) were excluded from this study.

Subjects ranged in age from 21 to 70 with a mean age of 57. They were all native speakers of English. All were at least 2 months post CVA at the time of the examination. All demonstrated normal hearing sensitivity for their age and showed auditory language comprehension to be superior to verbal language expression. The subjects were of lower and middle class background with at least 6th grade elementary school education.

Apparatus:

The articulatory assessment consisted of a random table of 290 high frequency words* primarily attained from the Thorndike-Lorge list of the most frequently used words in English. The list included 265 monosyllabic words and 25 polysyllabic words varying from 2 to 7 syllables in length. In total the following appeared:

1) 21 singleton consonants occurred 7 times in both the initial and final position of words with the exception of [h] which only occurred in the initial position.

2) 8 consonant clusters and 9 pure vowels only occurred 7 times in the initial position of words.

All of the words at the time of the test were recorded on a Panasonic tape recorder. For each subject, the experimental procedure was conducted in a sound treated room. The subject and examiner were seated directly opposite one another at a small table.

Procedure:

An elicited auditory imitation task was used. Before the test procedure began, the subject was told, "You are going to hear me say a word. Just repeat what I say." The subject was given 3 demonstration trials before testing began. During the trials, instructions were repeated or explained until the subject fully understood the procedure. After the demonstration trials were presented, an opaque divider was placed between the subject and the examiner. Therefore, the subject was unable to receive facial cues from the examiner during the testing procedure.

Subjects were given 5 seconds to respond. There was a 3 second delay before the next presentation of a word. If the subject failed to respond, the stimulus word was repeated once. Responses were tape recorded and later analyzed using the International Phonetic Alphabet (IPA). The recordings and transcribed utterances were checked for validity by another experimenter who was also trained to use the IPA. Conflicting transcriptions were reviewed together and resolved by a third trained examiner.

The transcribed utterances were tabulated for feature analysis to compare the performances between the 2 groups of subjects. Distinctive features of place, manner and voicing were analyzed and graphed, as well as addition and omission of vowels and consonants. In addition, phoneme position, monosyllabic vs. polysyllabic word production; vowel production vs. consonant production; articulatory transitions in polysyllabic words and initiation difficulties were analyzed.

Results

In general, our results show that the NVA group demonstrated a

*Word list available upon request

similar pattern to the VA group. However, the NVA group revealed twice as many phonemic and non-phonemic errors. Table 1 summarizes the types of phonemic errors for both groups with regard to the type of articulation errors (i.e. substitution, addition and omission) for vowels, singleton consonants and consonant clusters. Although the error patterns were similar for both groups, the NVA group appeared more severe.

Table 1

Average percent of types of errors for 5 NVA and 5 VA*

Substitution		NVA	VA
Manner:	Consonant	9.6	4.7
	Vowel	3	3.2
	Consonant Cluster	5	2
	Total	17.6	9.9
Place:	Consonant	10.0	6.8
	Vowel	5.0	4.6
	Consonant Cluster	5.6	2.5
	Total	20.6	13.8
Voicing:	Consonant	5.5	4.3
	Vowel	1.6	0
	Consonant Cluster	2.7	1.1
	Total	9.8	5.4
TOTAL:		48.0	29.1
Addition		**NVA**	**VA**
	Consonant	2.6	1.3
	Vowel	12.0	3.2
	Consonant Cluster	0	0
	Total	14.6	4.6
Omission		**NVA**	**VA**
	Consonant	23.9	13.5
	Vowel	6.6	4.4
	Consonant Cluster	25.3	13.8
	Total	55.8	21.7

* Consonants were averaged for initial and final positions; Consonant clusters and vowels were averaged for initial position only; Example of vowel omission: -n/on.

The NVA group showed a higher percentage of omission errors (55.8) whereas the VA group presented with more substitution errors (29.1). A surprising result was that both groups demonstrated a larger

percentage of errors with singleton consonants than with consonant clusters or vowels. This is somewhat contrary to previous investigations which have shown that consonant clusters tend to be most deviant.

It should also be noted in Table 1 that for both groups, vowels comprised the largest percentage of the addition errors and that there were no addition errors for consonant clusters. However, with omission errors, consonant clusters were most in error for both groups. With reference to substitution errors, singleton consonants were more in error for both groups.

Table 2 shows the substitution errors analyzed in terms of manner, place and voicing. It can be seen that the NVA group demonstrated twice as many substitution errors for voicing, manner and place of articulation as opposed to the VA group. The NVA group showed the greatest percentage of errors with manner (53.8) of articulation. However, the VA group showed manner (26.1) and place (26.3) errors to be both equally the most deviant.

Table 2

Average percent of substitution errors of manner, place and voicing for 5 NVA and 5 VA

	Manner	Place	Voicing
VA	26.1	26.3	18.5
NVA	53.8	47.8	37.2

With manner errors, affricatives and fricatives were in the greatest percentage of error for both groups. For the NVA group the labio-dental, velar and glottal /h/ were the most deviant place errors. For the VA group, labio-dental, velar, lingua-dental and the glottal /h/ were most deviant. For both groups, bilabials were least in error.

Overall, both groups demonstrated slightly more errors on the voiceless than voiced cognate pair. The greatest percentage of voicing errors for the NVA group was /f/ (85%). For the VA group, /θ/ (28%) was most in error. NVA errors were again more severe than for the VA group.

Table 3

Percentage of monosyllabic versus polysyllabic word errors

Type	NVA	VA
(1)		
I. Initiation Errors		
Monosyllabic	30.6	11.1
Polysyllabic	40.0	20.8
Total	20.2	11.9
II. Repetition Errors		
Monosyllabic	46.1	10.6
Polysyllabic	8.0	6.4
Total	8.2	10.3
(2)		
III. Transition Errors		
Monosyllabic	1.5	1.6
Polysyllabic	57.6	41.6
Total	6.4	5.0
(3)		
IV. Articulation Errors		
Monosyllabic	55.8	37.5
Polysyllabic	68.8	49.6
Total	61.5	35.4

(1) Initiation - undue silent periods, groping behaviors, audible struggle, silent blocks and repetitions.

(2) Transition - moving smoothly from phoneme to phoneme (monosyllabic words) and from syllable to syllable (polysyllabic words) without any audible break in production.

(3) Articulation - errors: If monosyllabic or polysyllabic words contained one or more phonemic errors, they were presently only counted once as being incorrect. These words were then counted to determine how many of the 290 words were misproduced.

In Table 3 it can be seen that the NVA group again seems to mirror the VA group but to a more severe degree, particularly with the articulation errors. Here articulation errors for both groups appeared to comprise the greatest part of their speech deficits in comparison to the other categories. With reference to the non-phonemic errors, there were twice as many initiation errors with the NVA than with the VA group, however, repetition and transition errors were equal. It should also be noted that in combining the initiation, repetition, and transitional errors for both groups, it becomes evident that the gradual initiation of voicing and the rapidly changing back and forth from voiced to voiceless states during speech is difficult. Specifically for both groups, initiation and transitional errors occurred more with

polysyllabic words. Whereas repetition errors occurred more with monosyllabic words.

For both groups, only slightly more phonemic errors occurred on singleton consonants in the initial position of monosyllabic words. However, the NVA group demonstrated twice as many errors in initial position than the VA group. Over 50% of the total phonemic errors were only one feature removed for both of our groups. Also, it is important to note that the combined one and two feature errors total approximately 89% of all the phonemic errors. This indicates that these phonemic errors were not random in nature.

Discussion

Our results reveal that the NVA group's phonemic and non-phonemic error patterns are remarkably similar to the VA group but of a more severe nature. These results are in accordance with DeRenzi et al's (1966) investigation. They showed a strong association between NVA (oral apraxia) and phonemic articulatory disorders of speech. In their study, severe phonemic articulatory disorders were primarily present with severe NVA, whereas minimal or no articulatory impairments were present with less severe NVA or when NVA was absent. DeRenzi hypothesizes that oral movements, both verbal and non-verbal are subserved by a single association area. Thus, a lesion such as in the parieto-temporal region might manifest itself through both verbal and oral non-verbal apraxia disorders.

The present study analysis of phonemic errors as well as non-phonemic errors were compared to previous studies dealing with apraxia of speech. Fry (1959), Shankweiler and Harris (1966), Trost and Canter (1974) and Deal and Darley (1972) all noted that substitutions were most predominantly in error as opposed to addition and omission errors. This finding is similar to the results found in our present study.

Manner of articulation errors were similar to previous findings. Fricatives and affricatives and glottal /h/ were most in error. Trost and Canter (1974) found that /v/, /ʃ/, /ŋ/, /θ/ and /j/ were most in error. Similar to other investigators, voicing errors in our study were also found to be less frequent. Our VA and NVA groups demonstrated slightly more errors in the voiceless than voiced cognate pairs which is similar to Shankweiler and Harris' (1966) results.

As in agreement with Fry (1959), Shankweiler and Harris (1966) and Trost and Canter (1974) our study also found that initial consonants were slightly more in error than the final consonants. Differences in results between ours and other studies may be due to methodology and subject population. As an example, Shankweiler and Harris (1966) grouped initiation and substitution errors as one unit and found differences with regard to position of a word. LaPointe (1975) separated initiation and substitution errors and found no differences in the position of a word.

However, in our present study, we separated initiation and substitution errors and found only a slight difference between errors in initial vs. final position. Also, while most other studies failed to include polysyllabic words for their investigations, the present study incorporated the latter. Thus we were able to analyze transitional errors which also appear to contribute significantly to their speech difficulties. As can be noted from our distinctive feature analyses (Table 1), our study included substitution, addition and omission errors of consonant clusters. Surprisingly, consonant clusters were not the most in error but rather singleton consonants. This is somewhat contrary to other investigative results.

Future studies investigating phonemic and non-phonemic error patterns in non-verbal oral apraxia and verbal apraxia should have their subjects controlled for specific age, severity and onset. Since spontaneous recovery might be affected by these 3 factors, it is therefore necessary to control for these prognostic indicators. For example, in the present study, Subject 1 was age 21 at the time of testing and was seen 13 months post a cerebral vascular accident. Her prognosis for recovery was better than for Subject 6 who was age 70 at the time of testing and was seen 9 months post a CVA. Future studies should also analyse and compare the phonemic and non-phonemic errors present in conversational speech. For both groups this type of analysis may provide a more accurate functional assessment of subjects' phonemic and non-phonemic difficulties rather than an auditory imitation task.

For the speech and language pathologist, this present investigation clearly shows the necessity of doing a complete analysis which should include both the phonemic and non-phonemic parameters. This would be necessary before attempting to formulate effective and systematic treatment programs. For example, this preliminary data can be used by the speech and language pathologist in structuring a treatment program based upon a hierarchy of easier to most difficult phonemes. Furthermore, the final position in a word may possibly be the more effective position chosen during the initial stages of treatment. Since the non-phonemic error patterns were significantly deviant for both groups, this indicates that both groups had difficulty in the gradual initiation of voicing and the rapidly changing back and forth from voiced to voiceless states during speech. Therefore, it is also essential that treatment strategies be implemented to facilitate the gentle initiation of words and the smooth transitions whether it is between syllables in words or between words in a phrase. Treatment cannot be totally effective if we fail to treat these and other non-phonemic parameters.

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Auditory identification and sequencing of linguistic and non-linguistic stimuli by three language impaired children

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Abstract

In assessing the auditory processing skills of normal and language impaired children, researchers have used a variety of stimuli ranging from complex tones to linguistic stimuli. This study was undertaken to compare the performance of three language impaired children on tone identification and tone sequencing tasks, as well as identification and sequencing of linguistic stimuli of varying complexity ranging from single words to four word phrases. The experimenters sought to determine whether increasing the linguistic complexity of the stimuli would result in a breakdown in the discrimination and/or sequencing skills of the language impaired children. Results indicated that for the subjects, increasing linguistic complexity did not cause a breakdown in identification skills. There was a significant difference ($p < .01$) between the identification of linguistic stimuli versus non-linguistic stimuli. Although no significant differences were noted in the ability to sequence linguistic as opposed to non-linguistic stimuli, scores for tasks involving the sequencing of non-linguistic stimuli were poorer than scores obtained for sequencing linguistic stimuli.

The basis of the disorders that are found in many language impaired children have been attributed to problems in auditory processing. (Monsees, 1961; Aten and Davis, 1968; Eisenson and Ingram, 1972). In an attempt to test the auditory processing skills in normal and language impaired subjects, experimenters used a variety of stimuli ranging from pure tones (Lowe and Campbell, 1965) to complex tones (Tallal and Piercy, 1973) to linguistic stimuli (Rosenthal, 1972). Many of these researchers generalized the results from such tests to the deficient language skills of language impaired children.

The validity of such generalizations has been questioned by Rees, (1973) and Thal, (1977). They suggest that perhaps non-linguistic stimuli are not appropriate for studies which are intended to provide answers to the problems of language impaired children. Rees states that the non-linguistic skills of tone identification and sequencing are not useful as predictors of language skills. A similar position was taken by Thal who suggests that tests which require identification and sequencing of non-linguistic stimuli are inappropriate to use in experiments which intend to interpret their results in terms of normal and deficient language skills.

Data from studies which have used both linguistic and non-linguistic stimuli in sequencing and identification tasks (Aten and Davis, 1968; Rosenthal, 1972) have demonstrated that both normal and language impaired

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subjects obtained higher scores when linguistic stimuli were used. However, normal subjects achieved higher scores on all tasks. A similar finding was reported by Thal (1977) who found that subjects performed better when word cues were given for sequencing and identification tasks.

Research to date indicates that linguistic stimuli seem more appropriate to use in testing identification and sequencing skills of language impaired subjects. Many questions remain, however, concerning the particular kinds of stimuli (phonemes, CV units, words) which are most appropriate. Tallal and Piercy (1974) used synthetic stop consonant-vowel constructions and synthetic vowels in a study which required the identification and sequencing of that stimuli. They generalized their findings of the poor performance of language impaired children on these tasks to their language deficits. A major drawback of using synthetic speech in this instance is that some measure is needed which shows that synthetic speech and natural speech are equivalent.

McReynolds (1966) compared the ability of language impaired and normal subjects to discriminate between natural speech sounds in isolation and in nonsense syllables. There was no significant difference between the scores of language impaired and normal subjects on discrimination of speech sounds in isolation. The scores of the language impaired subjects were significantly lower than the scores of normals when the sounds were in nonsense syllables.

Stark, Poppen and May (1967) used words to study the auditory sequencing abilities of language impaired subjects. Their results showed that there was a great degree of variability among the language impaired subjects. Both McReynolds (1966) and Stark et al, (1967) interpreted their results in terms of the language abilities of their subjects. Since they used linguistic stimuli, their generalizations may be justified, yet the relationship to larger units of speech remains a question.

The present study examines the relationship between the following: a) identification and sequencing of non-linguistic stimuli (tones) and b) the identification and sequencing of linguistic stimuli in combinations of increasing complexity that are below, at, or above the mean length of utterance (MLU) of each of the three language impaired subjects. The question to be explored is, as the linguistic stimuli become increasingly more complex, relative to a particular subject's MLU, does he have difficulty identifying and sequencing it?

Method

Subjects:

The subjects were three language impaired children drawn from the clinic population at the Queens College Speech and Hearing Center. The criteria used to define "language impairment" was outlined by Mykelbust (1971) as a failure to develop adequate language skills even though non-linguistic developmental milestones (reaching for objects,

sitting, standing, walking) are intact.

In order to focus as much as possible on the language disorder itself, children with normal motor development, hearing, and absence of apparent emotional disturbance were chosen. Descriptions of each subject follow:

J. was 5.4 years of age at the time of the study. Her mother reported a normal pregnancy and delivery. J's non-linguistic developmental milestones were within normal limits: she walked at 13 months, sat at 9 months. However, there was a noticeable delay in speech development (except for expressions like "da-da") until 3½ years of age. The results of a neurological examination revealed no definite abnormality. At the time of the experiment, J was enrolled in a public school readiness class for severely language impaired children. Her MLU at the time of the study was 2.43. The Assessment of Children's Language Comprehension (ACLC) (Foster, Giddan and Stark, 1973) was administered at the time of the study and J obtained a raw score of 63, which was indicative of language impairment.

C. was 4.0 years of age at the time of this experiment. His mother reported that he sat at 7 months and walked at 10 months. However, C did not use his first words until approximately 3 years of age. Prior to this time, expressive communication consisted primarily of babbling, pointing, and screaming. When this study was undertaken C's MLU was 2.8. His language consisted mainly of one and two word utterances, many of which were unintelligible or imitative. C also used a considerable amount of jargon. The ACLC was administered at the time of the study and C achieved a raw score of 58 which was indicative of language impairment.

D., 5 years of age at the time of the study, was born 7 - 8 weeks prematurely, the result of a toxemic pregnancy. D's mother reported that motor development occurred "all at once" but was within normal limits. There was a noticeable absence in speech development. D used her first intelligible words at 3 years of age. Prior to this, she used an elaborate gestural system to communicate her needs. At the time of the study, D's MLU was 3.47. Although her ACLC score did not indicate language impairment, her expressive language lacked many early occurring structures such as the -ing inflection at the time of the study. D was administered the Modified Token Test for Children and obtained a raw score of 47. Her errors fit the pattern exhibited by many language impaired children on this test (least errors on Part I, progressive deterioration of scores on Parts 2, 3, 4, improvement in performance on Part 5) according to Tallal (1975).

Apparatus:

The experiment was conducted in an 8'x 10' room in the Queens College Speech and Hearing Center. The subjects were seated in front of a Lehigh Valley Electronics Triple Level Human Test Console which was on a low table. Two response panels and a token dispenser were

mounted on the console. A token dispenser was situated between the two response panels. Stimuli were presented through Sennheiser model HD 424 headphones and subjects were required to press the appropriate panel or sequence of panels. A correct response was followed by a light flash on the token dispenser and receipt of a token. The tokens were later exchanged for a toy at the end of each session.

The equipment which controlled these functions was comprised of electromechanical relays and a programmable tape recorder. Control pulses were recorded on one track of a magnetic tape such that they preceded the experimental stimuli recorded on the other track. Another set of pulses immediately after the experimental stimuli stopped the programmable tape recorder. Control pulses activated electromechanical relays, so that when a subject depressed a response panel, a pulse was created which controlled the reinforcement mechanism. Incorrect responses prevented activation of the token dispenser. Responses were recorded by hand on a tally sheet for each set of twenty trials.

The stimuli used in the experiment were presented through headphones at a comfortable listening level. Each word or phrase was recorded onto an audio tape on a Sony Model TC-377 stereo tape recorder. The linguistic stimuli consisted of the following sets of words and phrases:

ball	cookie
throw ball	eat cookie
baby throw ball	mommy eat cookie
baby throw red ball	mommy eat big cookie

These stimuli were chosen because they were words or phrases below, at, or above the MLU of each subject. The nouns and verbs chosen were those familiar to the subjects.

The non-linguistic stimuli were two complex tones composed of frequencies within the speech range. Tone 1 had a fundamental frequency of 100 Hz and tone 2 had a fundamental frequency of 304 Hz.

Procedure:

The experiment was divided into training sessions and experimental sessions. The training sessions were designed to familiarize the subjects with the experimental environment and to teach them what kinds of responses were required. In the experimental sessions, the subjects were required to respond in the identification and sequencing tasks under four conditions of varying utterance length in each task. They were also required to respond in sequencing and identification tasks for the two complex tones.

Training Sessions:

Each subject was seated on a small chair in front of the test console. The experimenter placed headphones on the subjects' ears

and on her own. The subjects were given a series of instructions and demonstrations designed to familiarize them with the kinds of responses required. The instructions are described below:

> "We're going to listen to some words/sounds. When you hear the word/sound, press here (E. points to red circle). Watch me. Listen. (Word/tone presented) I heard it--now I press. Now you do it. (Word/tone presented) You heard it, now you press. Good!" Followed by 5 presentations of word/tone then the following instructions.
>
> "Now we're going to hear another word/sound. When you hear it, press here (E points to the blue square). Watch me. Listen. (Second word/second tone presented). I heard it--now I press. Now you do it."

During this part of the training procedure, the words "ball" and "cookie" were presented separately, five times each. A token and verbal reinforcement followed each correct response.

After five presentations of the word "ball" followed by five presentations of the word "cookie", the subjects were given another set of instructions and demonstrations described below:

> "Now sometimes you will press here (E points to key with red circle) and sometimes you will press here (E points to key with blue square). Listen and press the right one. Watch me first. (Word/tone presented). It was this one (E presses correct key). My turn again (Word/tone presented). Now it was this one (E. presses correct key). (Continued for five consecutive trials). Now it's your turn. Listen and press the right one."

The experimenter then gave 20 trials in which the words "ball" and "cookie" were presented randomly. During this part of the training procedure each subject was given as much help as possible to enable him to correctly respond.

This same procedure was followed for the discrimination of the words "throw-eat", "baby-mommy", and "big-red." Since a purpose of this study was to see if discrimination skills break down as a result of increased utterance length, all subjects were required to discriminate between the individual words.

Experimental Sessions:

In the experimental sessions, four different conditions of varying utterance length were presented and the subjects were required to respond in each condition on both identification and sequencing tasks.

The following experimental conditions were presented, in random order, two times each for twenty trials each time, except for condition 5 which was always presented last:

Condition 1:	single words	
	ball	cookie
Condition 2:	two words	
	throw ball	eat cookie
Condition 3:	three words	
	baby throw ball	mommy eat cookie
Condition 4:	four words	
	baby throw red ball	mommy eat big cookie
Condition 5:	two complex tones	
	Tone 1 100 Hz	Tone 2 304 Hz

In the identification tasks, one of the above conditions (1-4) was presented randomly to the subjects and they were required to respond by pressing a particular key depending upon which stimulus they heard. The instructions given were those previously described for the discrimination of the words "ball-cookie," "big-red," and "throw-eat." Once they completed the identification of conditions 1-4 described above, the subjects were required to respond in condition 5, for the identification of the two complex tones. The procedures for both tone and word discrimination tasks were identical.

In the sequencing task, the conditions under which the subjects were required to respond were identical to those of the identification task except that the subjects were required to press the panels in the same order as the order of the presentation of the words, phrases, or tones. A token was delivered only upon completion of the correct sequence of panel depressions. The subjects were then required to sequence the two complex tones in condition 5. The procedures for the sequencing of words and sequencing of tones were identical. The following instructions were given to the subjects for the sequencing tasks:

> "Now you will hear two words/sounds. Sometimes you will press here (E. presses key with red circle) and then here (E. presses key with blue square). Listen and press the right ones. Watch me first. (Words/tones presented). It was this one and then this one. (Continued for five consecutive trials). Now it's your t n. Listen and press the right ones."

When the subjects completed the experimental tasks, a language sample was taken from each and was analyzed according to the procedure

outlined by Tyack and Gottsleben (1974) and mean length of utterance was calculated.

Results

Table 1 presents the proportion of correct responses for each of the subjects in the five conditions.

Table 1

Proportion of correct responses in the identification and sequencing tasks for the three subjects

Condition	Subject					
	J		C		D	
	Iden.	Seq.	Iden.	Seq.	Iden.	Seq.
1. single words	.90*	.55	.90*	.70	.90*	.90*
2. two words	.86*	.70	.90*	.70	.95*	.86*
3. three words	.86*	.60	.95*	.80*	1.00*	.95*
4. four words	.90*	.57	.95*	.60	.95*	.84*
5. two complex tones	.40	.50	.45	.50	.62	.50

* Scores higher than would be expected by chance at the .01 level of confidence.

Subject J responded better than what would have been expected by chance (.01) in conditions 1-4 which involved the identification of linguistic stimuli. In the condition which involved responding to complex tones, she failed to respond above chance. Her responses in condition 5 were significantly poorer than her responses in conditions 1-4. On the sequencing tasks, J failed to respond above chance in all of the conditions.

Subject C responded better than expected by chance (.01) in all identification tasks except those involving complex tones. Responses to condition 5 were significantly poorer than to conditions 1-4. On the sequencing tasks he responded above chance only in condition 3.

Subject D responded well above chance on all of the identification tasks except those involving complex tones. There was a significant difference in scores obtained in condition 3 and 5. On the sequencing tasks, D responded above chance in all of the conditions except for the sequencing of complex tones. The differences obtained between conditions 3 and 5 were also significant.

Discussion

One of the issues this study sought to examine was the differences in language impaired children's performances on tasks using linguistic as opposed to non-linguistic stimuli.

The results are in agreement with the findings of other researchers (Thal, 1977; Rosenthal, 1972) in that for all three subjects, scores were better when linguistic stimuli were used as opposed to non-linguistic stimuli.

All subjects performed significantly better on tasks requiring the identification of linguistic stimuli of varying complexity than on the identification of complex tones. Although two of the three subjects demonstrated poorer scores on the sequencing tasks as opposed to the identification tasks, the sequencing of the non-linguistic stimuli was the poorest score obtained in any of the conditions.

In this study, all three language impaired subjects demonstrated some degree of linguistic performance skills for the identification and/or sequencing of linguistic stimuli of varying complexity, at the same time that they demonstrated little if any complex tone discrimination or sequencing skills. For all the subjects, failure to identify or sequence tones did not preclude their ability to identify or sequence words or phrases. Thus, the results of this study question some of the claims made by Tallal and Piercy (1973) who state that discrimination and sequencing skills for non-linguistic stimuli must precede those skills for more complex linguistic stimuli.

A second issue this study sought to examine was whether discrimination and/or sequencing skills break down as a result of increased utterance length. The results show that, for all subjects, there was no breakdown in discrimination skills as the linguistic stimuli ranged in complexity from single words to four word phrases. However, for two of the three subjects, increased linguistic complexity did result in significant breakdowns in their sequencing abilities. In general, scores on the sequencing tasks were lower across conditions than were scores on the identification tasks. This may suggest that the sequencing task is more difficult and requires better auditory processing skills.

As if in response to the increased difficulty of the sequencing tasks, all three subjects developed response strategies for these tasks. D repeated each utterance in the appropriate sequence aloud, and then pressed the correct panels. D's most common error with 3 and 4 word phrases consisted of pressing the panel corresponding to the last item she heard, first, even though she was able to repeat the correct sequence verbally.

J consistently repeated and pressed the appropriate panel for the last item she heard first, across conditions. J often failed to press a panel for the first she heard in the sequence. A similar response pattern was noted by Stark, Poppen, and May (1967) where

for some subjects, 75% of their errors were in the first position of the sequence. That is, their sequencing difficulties were largely due to their forgetting the first item in the sequence.

Subject C repeated all sequences verbally but inappropriately (out of sequence) yet he was able to depress the correct response panel for a particular sequence. Clearly, the part that such strategies or rehearsal behaviors play in aiding or impeding the performance of such tasks warrants further exploration.

With regard to scores on the sequencing tasks, each subject achieved the highest score in the conditon whose linguistic composition was closest to his own. J., whose MLU was 2.43, highest sequencing score was in condition 2 (two words). C., whose MLU was 2.87, highest sequencing score was in condition 3 (three words) and D., with an MLU of 3.47, scored highest in condition 3 (three words).

In conclusion, the subjects in this study performed better in identification and sequencing tasks when linguistic stimuli were used. Increasing linguistic complexity in terms of utterance length did not result in a breakdown in identification skills. Poorer scores were obtained on sequencing tasks than on identification tasks, however, tasks involving the sequencing of non-linguistic stimuli were poorer than scores obtained for the sequencing of linguistic stimuli. Performance with linguistic rather than non-linguistic stimuli appeared to be a better indication of the subjects' language abilities.

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Two Language Disordered Children and their Comprehension of Indirect Directives

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Abstract

This study evaluated two language disordered children and their comprehension of indirect directives. During the first phase the children were presented with sentence types that had more than one interpretation of meaning. In the second phase the examiners looked at the influence of informing responses and requests for actions of information. The results showed that the type of sequence influenced the pattern of response. The study suggested that the two subjects were able to take context into account and were not confined to literal interpretation.

There are many ways of expressing an idea in a language. Consider the sentence, "Can you raise the window?" A literal paraphrase of this sentence would be, "Are you able to raise the window?" There are circumstances that warrant such an interpretation. For example, a physical therapist might ask this of a patient with a broken arm and intend for it to serve as an information seeking question, where a yes or no answer is appropriate. However, in other situations, a literal interpretation is not intended. A speaker would know that the listener is capable of raising the window. In addition, the listener presupposes that the speaker is aware that he/she can raise the window. Given this mutually shared extralinguistic knowledge, plus some situational knowledge (e.g. the window is closed and it's hot), the listener infers that the speaker wants him to raise the window. When sentences like, "Can you raise the window?", are intended as requests for action, they are identified as indirect directives. Responses to indirect directives involve the listener's knowledge of "who can say what, in what way, where and when, by what means and to whom". (Hymes, 1971). These questions posed by Hymes have come to be referred to as the pragmatics of language.

Searle (1975) suggests that we understand sentences by first deriving the literal meaning of the sentence through using our knowledge of semantics and syntax; then we test the sentences in the particular context in which it is spoken, and if the literal meaning is inappropriate, we come up with alternatives based upon our knowledge of conversational principles.

Given Searle's theory, one might assume that children develop language comprehension by attending to literal meaning first; only later are they able to respond effectively to indirect meanings. Ervin-Tripp (1976) has suggested that the comprehension and production of request

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forms by children will proceed from direct imperatives, such as, "Give me the blanket", to indirect requests that are presumably based on conversational postulates, such as "Can you reach the blanket?" However, Bates (1971), with regard to the issue of comprehension of requests, analyzed video-taped mother-child conversations with two, three and four-year-olds. She compared request forms by mothers in terms of likelihood of both behavioral compliance and verbal response by children. The results showed that children were just as likely to comply with indirect requests as they were with direct commands. In another study by Shatz (1974, 1975) with normal two-year old children, it was shown that normal children respond as well to both literal requests for action (e.g. "Raise the window"), and to indirect directives (e.g. "Can you raise the window?"). Shatz has suggested that this is not because the children have complete syntactic and semantic knowledge as well as adult understandings of conversational postulates. Rather, she suggests that children have a simple action strategy for responding to language. That is, children act out or act upon what can be identified from the speech stream. With a strategy like this, children produce what seems like sophisticated behavior but do not necessarily possess the knowledge of the syntactic, semantic, and conversational rules.

Given this action strategy, the child does not learn literal meanings first and later some conversational-rule-dependent interpretations of them. Rather, the child must learn where it is appropriate to apply this action response strategy: this is done by the child learning to attend to the verbal or linguistic context of the message as well as the nonverbal contextual markers that signal the inappropriateness of an action response. If indeed this is the strategy used by normal children, what can be said about the strategy of the language disordered child with regard to the interpretation of indirect directives?

Sinclair (1976), has suggested that language disordered children process language too literally: that is, they do not take context into account, and therefore simply respond to the literal meaning of the message with action. It could be the case that language disordered children engage in linguistic interactions with the same action response strategies that normal children use but are less sensitive than normal children to the markers that would lead them away from action. For example, a language disordered child is involved in the conversation with an adult about the telephone (which happens to be in their presence). The child is asked, "Can your mother talk on the telephone?" and the child answers "yes". The adult then asks, "Can you talk on the telephone?" and the child responds by picking up the receiver of the telephone and pretending to be engaging in a conversation. The first question can be thought of as a contextual marker that the child should have considered when answering the second question.

In a study by Shatz, Bernstein and Shulman (1976) which dealt with the comprehension of indirect directives by language disordered children, it was reported that their language disordered subjects were not confined to literal interpretations as has been suggested, but could take context into account. Like Shatz's normal two-year olds, they responded to language by using an action strategy. At times, their subjects were

sensitive to markers which signalled that action was not appropriate, however, they still had difficulty taking such markers into account.

The purpose of this experiment is to study the language-impaired child's use of pragmatic skills. These skills make it possible for him to understand an utterance's meaning beyond that which is assigned to it by formal grammar. We are particularly interested in determining whether contextual factors interact with grammatical structures in order to determine meaning for each sentence type.

Method

Subjects

Subject 1, J, was a 5.4 year old language impaired female. J has been enrolled in language therapy at the Queens College Speech and Hearing Center for two-and-one-half years.

J, according to her speech and language pathologist, has a severe expressive speech and language disorder evidenced by the limited use of one and two word utterances. Numerous misarticulations are also noted. Behaviorally, J is easily distracted and unable to maintain attention for an extended amount of time.

Case history information states that developmentally, J's acquisition of both gross and fine motor skills was delayed. A delay was also noted in social skills. In addition, J exhibited a severe deficit in expressive language performance. In comprehending language, J was able to "identify categories of noun labels, as well as follow single commission commands".

A neurological evaluation revealed that J exhibits "diffuse neurological impairment in the basis of motor findings and problems with all aspects of higher integrative functions". A complete audiological examination revealed J's hearing to be within normal limits bilaterally.

The goal of J's language training program was to "expand language forms within a variety of content categories". Primarily, language forms were trained to express the regulatory, request and interaction functions. J was also involved in a play situation which fostered peer interactions and play development.

Subject 2, B, was a 5.1 year old language impaired male. B has been enrolled at Queens College Speech and Hearing Center for language therapy since February 1977. At the time of his enrollment, B was behaviorally described as "inappropriate" and "disruptive". B communicated gesturally and used single words. The results of diagnostic evaluations have led B to be labelled as "severely disturbed", "hyperactive", and "autistic". B's hearing was revealed to be within normal limits bilaterally.

B's behavior has been characterised by "ritualistic hand movements, unrelated laughing and smiling, and withdrawal from interactions with peers and adults".

Language training focused on the use of two and three word utterances encoding existence, non-existence, action, recurrence, locative, rejection, and attribution.

B was also involved in the play situation with J (subject 1).

Both subjects had an MLU of 2.0.

Apparatus:

The experiment was conducted in an 8' by 11' therapy room at the Queens College Speech and Hearing Center. The subjects were seen individually, and seated at a table opposite the experimenter. The experimenter presented the following sets of toys for Phase I :

1. toy dolls and horses
2. balls and toy trucks
3. toy chairs and dollhouse
4. plastic dogs and cars
5. male dolls and an airplane

Eleven sets of toys were used for Phase II and these included:

1. plastic fruits
2. toy trains and wooden animals
3. a picture and a book
4. toy barn and farm animals
5. toy cars and car carrier, snap-on trains
6. toy telephone
7. wooden animals and toy ark
8. dolls and toy swing set
9. dolls, a slinky cat, and a book
10. toy trucks
11. toy fire engine, fireman, and ladder

All of the testing situations were videotaped.

Procedure:

Phase I: Phase I attempted to assess the language impaired children's responses to sentence types that can have more than one reasonable interpretation of intended meaning. Each child was presented with five sets of toys, one set at a time. For example, the dolls and horses were one of the five possible sets.

As the child played with each set, he heard five sentence types (declarative, imperative, May you, Can + noun, Can you) that were related in content to that particular toy. For example, in the presence of the dolls and horses the experimenter said, "May you put the girl on the horse?" Filler sentences were interspersed among the test sentences so that the test sentences would not appear to be repetitions of each other. For example, in the second testing sequence which involved the balls and trucks, the following set of test sentences and

fillers were used:

Fit the ball in the truck. (test sentence)
This is a nice truck. (filler)
Can you fit the ball in the truck? (test sentence)
I like this ball. (filler)
The ball fits in the truck. (test sentence)
May you fit the ball in the truck? (test sentence)

The children heard twenty-five test sentences of five sentence types. Sentences 1 and 5 above, were control sentences, in that the first one is a direct request for action, and the last one does not function syntactically as an English directive.

The children's responses to these utterances were coded into two basic categories of meaningful responses:

(1) Action responses - responses in which the child performed or began to perform the action in response to the test utterance (e.g. the child put the ball in the truck).

(2) Informing responses - relevant verbalizations or responses which recognized the information seeking or giving aspect of the test utterance (e.g. "Yes it can"). It should be emphasized that action responses for this experiment, such as placing the ball in the truck, did not solely mean action. They could have been action plus language as long as that language was consonant with the child's taking the utterance as that requiring action.

Likewise, informing responses could have included action if the total response pattern indicated an informational interpretation. For example, if the examiner asked, "Can the ball fit in the truck?" and the child performed an action, such as picking up one of the balls and putting it into a truck to try it and then said, "It fits", that response was coded as an informing response, even though an action had been performed.

The examiner and a speech and language pathologist rated the responses of the subjects. It was judged as to whether the child's response was an action response or an informing response.

Phase II: Phase II was conducted in order to assess whether language disordered children could be influenced to produce more informing responses to those test items which could be interpreted as a request for action of information. The question was whether it was possible to reduce the tendency to respond with action when a literal or informational interpretation was actually intended and supported by context as well. Or, would the tendency to action remain regardless of the manipulation of context?

A subtest of sentence types used in Phase I were used to develop

a list of sentences that could be interpreted as either directives or as informational questions or statements. These test sentences were preceded either by three or four imperatives to foster a directive interpretation or by several informational questions to foster an informational interpretation. For example:

Directive Sequence:

Setting Sequence - Come get the telephone.
Push the button.
Find the 1.
Ring the bell.

Test sentence - Can you talk on the telephone?

Informational Sequence:

Setting Sequence - Who talks on the telephone in your house?
Can Mommy talk on the telephone?
Can Daddy talk on the telephone?
Can (sibling or pet) talk on the telephone?
Can a dolly talk on the telephone?

Test sentence - Can you talk on the telephone?

The responses to the test sentences were checked to see whether different sentences that preceded the test item might have had a different effect on the nature of the response to the test item. This design followed the paradigm of psychologists' "set" experiments. That is, the subjects were presented with the same stimuli twice, but each time the test stimulus was preceded by different "setting" stimuli, in this case three or four direct imperatives or three or four informational questions. The combination of a series of setting sentences plus a test sentence is called a sequence. Both subjects heard eighteen sequences. A toy relating to the setting sequence was present for the subject to manipulate.

For a child to pass a given group of sentences within a sequence, he had to respond correctly to two out of three, or three out of four sentences, in that sequence. Responses to these sentences were coded according to the categories previously described in Phase I, that is, action response or informing response.

Results and Discussion

It must be mentioned here that there were some cases that could not be coded as action or informing responses. For example, when a child ignored the examiner's utterance or said "No" without any attempt at action. However, most of the responses could be coded as meaningful.

If children use the sort of action-oriented strategy previously described, there should be no differences in the tendency to respond with action on the basis of sentence type and the proportion of action responses should be high. If they respond only to literal meaning,

more action on imperative and informing responses should be found than on other forms. Table I shows that Shatz's normal children, Shatz, Bernstein, and Shulman's language disordered children, and the language disordered subjects of this research, produce mostly action responses to these sentences and very few informing responses.

Table I

Average Percentage of Action Responses to Meaningful Responses

Population	Sentence Type				
	Imperative	Can You	Can + N	Declarative	May you
Normal (Slatz)	100	90	85	88	88
Language Disordered (Slatz, Bernstein, Shulman)	100	100	100	100	90
Language Disordered (Royster-Branker, Bernstein)	80	60	90	90	90

One could argue, on the basis of these figures, that there is evidence for nothing but an action strategy. But the findings of the second phase must be considered before that statement is made.

Before examining the responses to the test sentences in Phase II, it is necessary to consider the responses to the setting sentences themselves. It was important for the children to show evidence of appropriately interpreting the setting sentences which were chosen to be as unambiguous as possible in the context. If the children did not show this ability to respond differentially to utterances which were clearly imperative or informational, then obviously they could not be "set" and one could not look for effects of set on the interpretation of test sentences. Moreover, if the children did not produce informing responses even when they were clearly called for, one would have to consider the possibility that the tendency to respond with action found in Phase I was necessitated by response deficiency, a difficulty in producing informing responses under any circumstances.

The percentage of sequences in which the subjects were considered to have passed the group of setting sentences was 78 percent in the directive sequence and 25 percent in the informational sequence. Even though the percentage passed of informational setting sequences is considerably lower than the percentage passed of directive setting sequences, the language disordered children did possess the ability to make informational responses. The strong tendency to action responding found in Phase I is not totally attributable to an informing response deficiency. It is important to mention, however, that it was generally difficult to "set" the subjects on the informational and directive sequences. For example:

(a) it was necessary to repeat many of the setting sentences, and
(b) many times attentional devices, such as interjecting the child's name, had to be used.

Once it was established that the children could differentially respond to the setting sentences, it was feasible to examine their responses to the test sentences in each of the two types of sequences. Recall that the test sentences, given a literal reading, carry an informational meaning, and they can also function as directives. Evidence for an action-response strategy will be found if the tendency to respond with action persists despite the nature of the setting sequences, half of which should foster informational interpretations.

Table 2 shows the results of coding the responses to all of the test sentences which occurred in sequences the subjects were judged to have "passed" and for which they produced meaningful responses for each type of sequence, informational and directive.

Table 2

Average Percentage of Action Responses to Test Utterances

Population	Sentence Type	
	Directive	Informational
Normal (Slatz)	95	30
Language Disordered (Slatz, Bernstein, Shulman)	85	35
Language Disordered (Royster-Branker, Bernstein)	88	38

Comparing the language disordered children of this study, with Shatz's normal children and the language disordered children of the study done by Shatz, Bernstein, and Shulman, we see that the children of this study performed similarly to the children of the other studies. Clearly, the type of sequence influenced the child's pattern of responding. Thus, it is apparent that even language disordered children are sensitive to prior linguistic context. However, despite the influence of sequence, most of the responses of the language disordered children on the informational sequence were still action responses. In fact, these children and the language disordered children of the Shatz, Bernstein, and Shulman study produced fewer informing responses on these ambiguous test sentences than Shatz's normals who were much younger. Therefore, it may be the case that these children have difficulty taking into account some of the contextual and linguistic markers which would signal the inappropriateness of action and which would lead them away from action responses.

In summary, it is evident that the language disordered children of this study are not confined to literal interpretations, as has been suggested. They can take context into account. Like Shatz's normal two-year olds and the language disordered children of Shatz, Bernstein and Shulman, the children of this study respond to language using an action strategy. However, it should also be recalled that we had more difficulty "setting" the language disordered children than Shatz had with normals. This may speak to the additional attentional difficulties of the language disordered population. While they may at times be sensitive to markers which signal that action is not appropriate, they may still have difficulty taking such markers into account.

Future research is needed to investigate the responses of normal five-year-olds to these experimental tasks. It is possible that normal five-year-olds produce less action in neutral contexts like Phase I than either the normal two-year-olds or the language impaired children. Their responses to utterances like these will give us more information on whether and how the language disordered population differs from children developing a normal understanding of language in context. Through this and future research, we may be better able to pinpoint more specifically where the deficiencies of the language disordered children are, as well as the range of such deficiencies. Only with such knowledge will we be able to design appropriate therapies such that we can assure that these children will be able not just to parrot grammatical structures, but will be full participants in communicative interactions.

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Appendix A
Sentence Types: Phase I

A.

May you put the girl on the horse?
Fit the girl on the horse.
The girl fits on the horse.
Can the girl fit on the horse?
Can you fit the girl on the horse?

B.

Can you fit the ball in the truck?
The ball fits in the truck.
Can the ball fit in the truck?
Put the ball in the truck.
May you fit the ball in the truck?

C.

Put the chair in the house.
May you put the chair in the house?
Can you put the chair in the house?
The chair goes in the house.
Can the chair go in the house?

D.

The dog goes in the car.
Can the dog go in the car?
May you put the dog in the car?
Can you put the dog in the car?
Put the dog in the car.

E.

Can the man go on the plane?
Can you put the man on the plane?
Put the man on the plane.
May you put the man on the plane?
The man goes on the plane.

Appendix B
Informational and Directive Sentence Sequences: Phase II

A^1

Is this an apple?
What is this?
Is this a fruit?
Is this yellow?
Can you eat this apple?

A^2

Touch your nose.
Clap your hands.
Show me your tongue.
Stand up.
Can you jump?

B^1

Some trains carry things.
This train can't carry things.
It's the engine.
This train can carry things.
This train can carry things.
This train can't carry things.
Can this train carry things?

B^2

Hook the trains together.
Put them all together.
Put the lamb in here.
Put the dog on the red one.
Can this train carry things?

C

Come look at my picture.
The girl is holding a doll.
Do you see the chair?
The cat is on the rug.
Is the boy looking at a book?
Can you look at a book?

D^1

There are two chickens.
The ducks go quack-quack.
Here is a mama pig and her baby.
A sheep has soft fur.
The horse goes in the barn.

D^2

Put the chickens over here.
Get the other duck.
Give the pigs some food.
Put the sheep inside the fence.
The horse goes in the barn.

E^1

Take the cars off the truck.
This is Popeye's car.
Give Popeye's car a push.
Put Popeye's car on the truck.
Push the lady's car.
Can your car go on the truck?

E^2

Look I have trains too.
They snap together.
Do I have two blue ones?
There's a yellow one too.
Can the trains go on the truck?

F^1

Come get the telephone.
Push the button.
Find the 1.
Make the bell ring.
Can you talk on the telephone?

F^2

Who talks on the telephone in your house?
Can Mommy talk on the telephone?
Can Daddy talk on the telephone?
Can (sibling/pet) talk on the telephone?
Can you talk on the telephone?

G

Find the elephant.
Put the elephant on the boat.
Get the pig.
Find the other pig.
The giraffe goes on the boat.

H^1

This doll is just like these.
It can fit in the swing.

This doll can't fit in the swing.
This doll can't fit in the swing.
This doll can fit in the swing.
Can this doll fit in the swing?

H^2

Put this doll in here.
Put this doll on the slide.
Push the doll down the slide.
Fit this doll on the merry-go-round.
Can this doll fit in the swing?

I^1

Open the box.
Give the kitty a ride.
Pull it to (person).
Put the kitty in the box.
Can you look at a book?

I^2

This girl is sleeping.
This girl is playing with buttons.
This girl is picking up her doll.
She hugs her doll.
Can you hug a doll?

J

This truck can hold dirt.
This truck can't hold anything.
This truck can hold logs.
This truck can't hold anything.
This truck can hold something.

K

Look at my fire engine.
Pull up the ladder.
Put the fireman on the ladder.
Make the bell ring.
The fireman climbs up the ladder.

The use of the differential loudness summation test with children with sensory-neural hearing losses

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Abstract

Acoustic reflex thresholds for pure tones and white noise were used to predict the degree of hearing loss in 16 ears with sensory-neural hearing loss. The slope of the configuration was predicted using low-pass and high-pass filtered noise. The predictive accuracy of severity alone was 50% and the predictive accuracy of slope alone was 50%.

The Differential Loudness Summation Test (DLST) can aid in the prediction of degree and slope of sensory-neural hearing loss. Niemeyer and Sesterhen (1974) proposed a formula for the DLST to predict hearing threshold levels from a consideration of the relation between acoustic reflex thresholds for pure tones and broad-band noise. They predicted the hearing threshold in 223 ears with an accuracy of ±20db in 100% of the patients. Jerger, Burney, Maudlin and Crump (1974) evaluated this formula by testing 1,156 patients to estimate the degree and slope of hearing loss. They found that the prediction of the severity of impairment was quite accurate and that serious errors (prediction in error in two or more categories) occurred in only 4% of the cases. The predictive accuracy of the slope of configuration in 113 subjects was reported to be 60%, and again serious errors occurred in only 4% of the cases. Miller, Davies and Gibson (1976) investigated the accuracy of the formula when the test was performed on 100 ears, and found the severity of hearing loss to within -15 to +25db in over 90% of the cases. Schwartz and Sanders (1976) reported a predictive accuracy of 75% of 40 subjects and serious errors occurred for only one subject (2.5%).

Zwicker, Flottorp and Stevens (1957) presented evidence for the existence of a critical band in loudness summation. They reported that when the spacing between a group of pure tones is increased, the loudness remains constant until a critical point is reached, after which the loudness increases. The same effect occurs when the band-width of a band of noise of constant SPL is increased. Popolka, Karlovich and Wiley (1974) have demonstrated the existence of the critical band-width effect for the acoustic reflex.

A pure tone is confined to a single critical band, while noise derives loudness from several critical bands. It takes less noise intensity than intensity of a pure tone to elicit an acoustic reflex (Deutsch, 1972). The critical band is abnormally wide in the case of sensory-neural hearing loss, and the widening of the bands reduces the number of critical bands available for loudness summation, resulting in a smaller difference between pure tone and noise reflex thresholds (Niemeyer and Sesterhen, 1974; Jerger et al, 1974; Schwartz and Sander, 1976). It is this relation between the acoustic reflex for pure tones

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and wide-band noise that forms the basis for predicting hearing loss from reflex thresholds.

Jerger et al (1974) suggested that the importance of the DLST might be in the application of the procedure in the evaluation of hearing loss in young children.

The purpose of this study was to establish the accuracy of the procedure in the evaluation of the degree and slope of sensory-neural hearing loss in young children. The DLST is an objective test which assesses the patient's hearing ability without the patient's active cooperation. The testing technique is well-suited for young difficult-to-test children since it is objective, quick and easy to perform.

Method

Subjects:

Eight subjects with sensory-neural hearing losses, ranging in age from 3 years to 12 years with a mean age of 7 years were used in this study. Tympanometry was performed to eliminate children with conductive pathology from the experiment. A pure-tone audiometric evaluation was performed for each subject. The subjects were placed into one of two groups (mild-moderate, severe) representing the categories described by Jerger et al (1974). The criterion for a mild-moderate loss was a PTA of 20 to 49db HTL; a PTA of 50 to 84db HTL was defined as a severe loss.

Apparatus:

Pure-tone threshold testing was done in an IAC sound-treated booth. The test signal was delivered by a portable audiometer (Beltone, Model 10D) and transduced in a set of TDH-39 earphones mounted in MX 41 AR cushions. Tympanograms and reflex thresholds for pure tones, white noise, low-pass and high-pass filtered noise were obtained with an electroacoustic impedance bridge (American Electromedics, Model 83).

Procedure:

As recommended by Jerger et al (1974), a biological method was used to calibrate the impedance bridge, which resulted in a correction figure. This permitted a direct comparison with Jerger's et al (1974) predictive criteria. The biological calibration was accomplished by measuring reflex thresholds for pure tone and noise signals on ten young normal adults, age 21 years to 23 years with a mean age of 22 years and averaging the results. An earlier study, Dobry and Mazor (1978), showed that calibration using young normal children produced correction values which did not differ from the values obtained when young normal adults were used. The average reflex threshold for white noise was subtracted from the average reflex threshold for the three pure tones of 500, 1000 and 2000Hz, resulting in a value of 19db. This value was the norm for the equipment used in this study. In order to compare the findings of this study to Jerger's et al (1974) results, our norm

was subtracted from their norm (25db), resulting in a correction factor of 6db. Adding the correction factor to the findings for each subject allowed the interpretation of the results according to Jerger's et al (1974) predictive criteria. To predict the slope, a similar biological calibration was carried out for low and high-pass noise bands, resulting in a correction factor of 10db.

The DLST was performed following the instructions in the electro-acoustic bridge manual. Acoustic reflex thresholds for pure tones at 500, 1000 and 2000Hz were found (and averaged), as well as acoustic reflex thresholds for white noise. These values were used to calculate a difference score to predict the degree of hearing loss according to three categories: normal > 20db; mild to moderate 10-20db; severe 0-10db.

The slope of audiometric configuration was calculated by obtaining the difference between reflex thresholds for low-pass and high-pass filtered white noise. The predicted slope was compared to actual audiometric contour by determining the difference between thresholds at 1000 and 4000Hz.

Results

For each subject the degree of hearing loss was predicted from the acoustic reflex thresholds for pure tones and white noise. Table I shows a comparison of predicted loss with the actual audiogram of the subjects tested. Of the 10 ears which actually had mild-moderate loss, 2 were predicted to have normal hearing, 4 were predicted to have mild-moderate loss, and 4 were predicted to have severe loss. Of the 6 ears in the severe category, 2 were predicted as mild-moderate and 4 were predicted as severe. In 4 ears the DLST predicted better hearing than actual result. Two severe ears were predicted as mild-moderate and 2 mild-moderate ears were predicted as normal. The test predicted poorer hearing in 4 ears than the actual result: 4 mild-moderate ears were predicted as severe. In only 3 subjects was prediction of severity correct for both ears. Two of these subjects had severe bilateral losses, and one was the mild-moderate category.

Table I

Prediction of severity of loss for 16 ears (8 subjects) with sensory-neural hearing loss.

Actual	Predicte Normal	Mild-moderate	Severe
Mild-moderate	2	4	4
Severe		2	4

Table 2 summarizes the distribution of the predictive errors reflected in Table I. Errors were categorized into three types, similar to those of Jerger's et al (1974). There was no error if prediction

and actual result agreed. If prediction and actual result diverged by only one category for example, prediction "severe" but actual result "mild-moderate", then the error was considered "moderate". If prediction and actual result diverged by two categories, then the error was considered "serious".

In general, prediction was correct in only 50% of the ears tested (8 ears). Prediction was in error by only one category (moderate error) in 50% of the ears (8 ears). In no instance was prediction in error by more than one category (serious error). However, one subject with mild-moderate hearing loss was classified as having normal hearing bilaterally.

Table 2

Distribution of predictive errors.

Type of Error	Number of Ears	Percentage
None	8	50
Moderate	3	50
Serious	0	0

The predictive accuracy was somewhat better for the slope of the audiogram. Prediction was correct in 63% of the ears (10 out of 16 ears). Slope testing indicated correctly 10 gradual slopes. In 3 ears the prediction was gradual and the actual result was flat, and in the 3 remaining ears the prediction was flat and the actual result was gradual.

Discussion

Although the results of this study fail to support the accuracy of the DLST, prediction of degree or slope of hearing loss was never in error by more than one category. Two of the ears (one subject) with mild-moderate loss were classified as normal by the DLST. While this does not violate the operational definition of "serious" error, such errors are viewed with alarm by the present investigators.

The results were examined to discern a pattern that could be used to develop a suitable correction factor. For example, if the test always predicted better hearing, a single correction factor could possibly be applied to each result to arrive at a more accurate prediction of a subject's hearing. However, this was not the case. In 4 ears, the DLST predicted better hearing than the actual result, and in 4 ears the DLST predicted poorer hearing. Clearly, no pattern emerged in examining the results of this study. While further investigation may refine this type of procedure, present clinical instrumentation used for the DLST appears to produce a false negative rate that is unacceptable.

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Appendix

Hearing threshold and pure tone, white noise, low and high-pass reflex thresholds for eight subjects.

Subject 1

	Frequency (Hz)				(HTL)
	500	1000	2000	4000	
AD	25	35	45	50	Hearing Threshold
AS	40	40	40	40	

	Frequency (Hz)				(SPL)		
	500	1000	2000	W/N	LP	HP	
AD	86	87	94	90	96	96	Reflex Threshold
AS	86	87	94	90	96	96	

Subject 2

	Frequency (Hz)				(HTL)
	500	1000	2000	4000	
AD	30	30	40	50	Hearing Threshold
AS	30	40	45	40	

	Frequency (Hz)				(SPL)		
	500	1000	2000	W/N	LP	HP	
AD	116	112	114	105	106	116	Reflex Threshold
AS	121	117	124	120	106	121	

Subject 3

	Frequency (Hz)				(HTL)
	500	1000	2000	4000	
AD	35	40	45	40	Hearing Threshold
AS	35	40	45	50	

	Frequency (Hz)				(SPL)		
	500	1000	2000	W/N	LP	HP	
AD	96	97	99	70	81	96	Reflex Threshold
AS	91	97	104	75	91	96	

Subject 4

	Frequency (Hz)				(HTL)
	500	1000	2000	4000	
AD	25	25	35	45	Hearing Threshold
AS	30	30	35	45	

	Frequency (Hz)				(SPL)		
	500	1000	2000	W/N	LP	HP	
AD	96	92	100	85	96	111	Reflex Threshold
AS	96	87	105	90	96	111	

Subject 5

	Frequency (Hz) (HTL)				
	500	1000	2000	4000	
AD	30	35	35	50	Hearing Threshold
AS	30	30	35	45	

	Frequency (Hz)			(SPL)			
	500	1000	2000	W/N	LP	HP	
AD	101	92	94	85	86	101	Reflex Threshold
AS	106	97	94	95	86	101	

Subject 6

	Frequency (Hz) (HTL)				
	500	1000	2000	4000	
AD	50	60	65	80	Hearing Threshold
AS	50	65	65	80	

	Frequency (Hz)			(SPL)			
	500	1000	2000	W/N	LP	HP	
AD	91	82	89	95	101	116	Reflex Threshold
AS	91	87	89	95	106	121	

Subject 7

	Frequency (Hz) (HTL)				
	500	1000	2000	4000	
AD	70	75	80	100	Hearing Threshold
AS	70	75	80	95	

	Frequency (Hz)			(SPL)			
	500	1000	2000	W/N	LP	HP	
AD	106	97	104	90	96	101	Reflex Threshold
AS	106	102	104	95	91	106	

Subject 8

	Frequency (Hz) (HTL)				
	500	1000	2000	4000	
AD	45	50	55	60	Hearing Threshold
AS	50	50	60	70	

	Frequency (Hz)			(SPL)			
	500	1000	2000	W/N	LP	HP	
AD	96	102	104	100	96	111	Reflex Threshold
AS	96	102	104	100	101	116	

Developing Conversational Skills in a Language Impaired Child through Television Modeling

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Abstract

This study investigated the efficacy of modeling as a method for teaching communication within the context of topic related discourse. The procedure used television as a means of demonstrating conversational behaviors. The results indicated that modeling increased the production of contingent and novel utterances in the communication dyad. The results also showed that as information was added to antecedent responses, there was a decrease in the number of inappropriate utterances. The authors discuss the teacher's use of television in the development of language related behaviors.

It is evident from the literature that normal children show the ability to maintain semantically coherent dialogues by the age of three years. They are able to produce utterances that share and add new information to the topic of conversation. Experimental studies examine language usage in normal and disordered populations. Some of the studies indicate that atypical children exhibit differences from normals in both the structure and usage of language (Leonard, 1972, Geller and Wollner, 1976). Gallagher and Darnton (1978) studied children who were not understood in communicative interaction. They observed that while normal and language disordered children revised their linguistic forms, the latter group did not use the linguistic structures they were capable of producing.

With communicative interaction of primary importance to the teacher, authors like Bloom and Lahey have presented goals to facilitate the development of language competence. Among the guidelines is the ability to talk about present referents, followed by the production of language relating to objects and events further distanced, and the addition of information to a prior utterance.

The normal child's progression toward discourse must be viewed within the context of socially interactive skills. Escalona (1973) examined the transmissive and responsive behaviors exhibited by young children prior to the appearance of dialogue. She noted that young infants participate in activities like reciprocal gaze behavior and vocal turn-taking. By the end of the first year children are able to comply with requests, and initiate interactions. Escalona suggested that these early reciprocal exchanges are precursors to language interaction.

The eventual reciprocity that appears in dialogue requires the participants to use a number of linguistic and nonlinguistic skills. These behaviors include turn taking, understanding the listener's perspective, initiating, sustaining and terminating a topic of discourse.

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Since dialogue is a central goal in the development of language competence it is important for the teacher to understand how conversation is maintained. Grice (1969) stated that relevance is the primary maxim for participating in discourse. Bloom, Rocissano, and Hood (1976) viewed relevance as dependent on the child's ability to produce utterances semantically related to the prior language of another speaker.

An important aspect of relevance relates to the child's ability to maintain themes of conversation. Rees (1978) observed that young children are different than the adult in their ability to sustain a topic of discourse over successive exchanges. Bloom et al (1976) reported that school children rarely sustain a topic beyond two utterances. Teachers observe that the topically irrelevant language of the young child changes with age. With knowledge, experience and age children move toward linguistic themes in dialogue.

Our knowledge of discourse must take into account not only a description of the event but also the strategies children use to develop their skills. Keenan (1974) found that the child's repetitions of the speaker served to acknowledge the partner's antecedent utterance. Self-repetitions occurred when the expected response from the partner was not forthcoming. Repetitions become a means of establishing communicative competence in discourse.

While strategies for linguistic interaction emerge in the normal child, the disordered child is often unable to find ways of using complex language. The eventual development of linguistic skills for all children may be the result of observing appropriate responses and then imitating the model's behavior in a contextually similar situation (Hilgard and Bower, 1975). The success of modeling is dependent on two variables: attention and retention. The latter factor is considered when the teacher manipulates the division of time between the model and the response. Both variables are central to the end goal of generalization.

While the present study is primarily concerned with the development of conversational skills in a language disordered child, the authors also considered the format for effective learning. The use of a televised model seemed appropriate in view of children's interest in shows like Sesame Street and The Electric Company. Noting the value of the medium, studies have begun to show an increasing use of television in the preparation of experimental procedures. Cairns and Hsu (1978), for example, televised an environment of planned events. Using prepared scripts of actions the subjects answered questions about the observed interactions. The results were used to define the emergence developmentally of question concepts in children. Studies like the one described permit the teacher to introduce a prepared and repeatable context similar to the real situation. Taping children's built-in TV behavior (watching, listening and even respond the medium provides a core experience from which children demonstrat their linguistic knowledge and learn new skills.

The purpose of this study was to determine if modeling through television would be effective in teaching a language-delayed child to maintain appropriate interaction in discourse. The essential language format used for demonstration relied upon topic-related comments that added information to the antecedent language of a conversational partner.

Method

Subject:

M. was a 5 year old male who had received speech and language for 1½ years at the Queens College Speech and Hearing Center. At the time of the initial interview M's expressive verbal behaviors indicated delay. The child's language was often unintelligible primarily due to M's extensive use of jargon. Observing contextual clues, the jargon appeared to be communicative rather than self-stimulatory in nature. M's hearing was found to be normal.

This child's father continued to report over time that M had few playmates. With the mother working and the father chronically ill, M's daily routine often included staying in his room and watching television.

At the time of the study, M had a MLU of 3.27. This child's language consisted of short complete sentences and phrases, telegraphic utterances, and jargon. M found it difficult to sustain conversation with adults and children. Obstacles to successful dialogue included self-repetitions, jargon and M's failure to orient the listener to tangential associations. This child, nevertheless, showed increasing interest in nonverbal and verbal interactions.

Apparatus:

The experimental procedure was conducted in a 10' x 15' room at the Queens College Speech and Hearing Center. The subject's behavior and the contextual clues were transcribed by a trained observer in the room. The ten lexical items used in the experiment were represented with objects. Interaction with the five trained items was recorded on videotape. The child's language was recorded on an audio tape cassette and replayed for analysis as a check of reliability.

Procedure:

Using three informal play-sessions, the experimenters gathered a corpus of 's language with five pairs of stimuli matched for similarity of function and attributes.

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Table 1

Lexical Items

Category	Trained	Untrained
Food	Cookie	Candy
Transportation	Airplane	Car
Clothing	Glove	Hat
Drawing Utensil	Pencil	Crayon
Animal	Cat	Dog

The content of the experimenter's language and the model of discourse was prepared from the subject's language corpus (see Appendix). The discourse model included a request for the label and comments of function, attribution and possession. Each dialogue consisted of six shared exchanges with the label request initiating the communicative interaction. As each speaker took a conversational turn, the stimulus was transferred to permit object manipulation and to underline the reciprocal nature of dialogue.

The general style of the show was modeled after the "Mister Rogers" program. One of the authors was introduced as "Mister Robert" on the videotape. The child was directed to attend to verbal and nonverbal interactions. The event was described as "two friends having a good time talking." Mister Robert described "talk playing like ball playing."

Four pretraining baselines were presented for each level of measurement with the order of stimulus presentation randomized throughout.

Training with videotape took place over seven sessions with a live practice interaction following each video model. After three trained interactions with one object, the format for intervention was presented with the next item. During live training the experimenter replicated language from the videotape. There were no content requirements for the subject to follow. If M made no response within a seven second time interval, the experimenter took the stimulus and produced a different contingent message. If the child's response was incomplete (judged by time and intonation) his conversational turn was completed without a time restriction.

Post-training baseline I followed the modeling procedures and presented the trained stimuli followed by the untrained pair. Post-training baseline II presented the five untrained stimuli independent of their semantic counterparts.

The authors modified categories presented by Bloom et al (1976) for coding the child's language in discourse.

Table 2

Categories of Verbal Discourse

Contingent	same topic with new information
Non-contingent	different topic
Imitation	same topic without new information
Imitation and Expansion	same topic, antecedent utterance repeated and new information added
Self repetition	same topic with perseveration of the subject's prior utterance
Total jargon	unintelligible utterance
Partial jargon	utterance containing intelligible and unintelligible elements (double coded)
Agreement	"Yeah"
No response	absence of verbal response

Results

Table 3 compares the number of responses within each category in the pre and post baseline measurements. After modeling, observable change with trained stimuli was recorded in the categories of Contingency (27 to 36), Self Repetition (8 to 3), and Partial Jargon (15 to 4). With untrained items change was noted in the categories of Contingency (24 to 46,46), Non-contingency (8 to 2,2) Self-Repetition (7 to 2,1) Total Jargon (8 to 2,1) Partial Jargon (15 to 3,3) and No Response (8 to 2,1). There were more responses for the trained stimuli (78 and 80) than untrained items (71 and 64,66).

Table 3

The Effect of Intervention

Category	Trained Pre	Trained Post	Untrained Pre	Untrained Post I	Untrained Post II
Contingent	27	36	24	46	46
Non-contingent	2	5	8	2	2
Imitation	3	4	1	2	2
Imitation and Expansion	6	5	3	4	5
Self Repetition	8	3	7	2	1
Total Jargon	6	4	8	2	1
Partial Jargon	15	4	15	3	3
Agreement	7	4	5	1	5
No Response	4	3	8	2	1
Total	78	80	71	64	66

The use of novel utterances (defined as language content not appearing in the original corpus, pre-baseline and modeling) is presented in Table 4. Most novel utterances appeared in the Contingency category (trained 10, untrained 12,22). Since Non-contingency did not appear in the models, all of the child's responses in this category were classified as novel.

Table 4

Novel Utterances

Category	Trained Post	Untrained Post I	Untrained Post II
Contingent	10	12	22
Non-contingent	5	2	2
Imitation and Expansion	2	1	2
Total	17	15	26

Discussion

The results of the present investigation demonstrated the efficacy of modeling as a method for improving topic related discourse in a language impaired child. The Contingency category showed the most significant change following the training procedures. This result may have been established by the predominate use of Contingency responses on the videotape. The reduction of partial jargon after training may have expanded the familiar format of Contingency.

Bloom et al (1974) found that children imitate language they are in the process of learning. The data showed that imitative utterances were relatively infrequent in the subject's response patterns. Since the purpose of the experiment was not to teach new language but to use existing forms in a more appropriate manner, imitation may not have been relevant to the interaction.

Most of M's novel utterances appeared in the Contingent and Non-contingent categories. Non-contingent utterances were novel, and initiated topic shifts. The appearance of Contingent novel utterances suggested that in addition to imitating language the subject added new concepts to maintain the dialogue.

Given this child's interest in television the videotape provided the subject with a useful and familiar format for learning. The child was able to bring prior experiences with television into the experimental procedure. The appropriate nonverbal behaviors of watching and learning served as precursors for the appearance of verbal behaviors. In addition to the attention factor the use of television permits the clinician to present individual facets of conversations that could eventually be placed into expanded versions of the dyads.

Analyzing the data, the authors realized that videotaping the child in conversational dyads would have permitted the analysis of the nonverbal aspects of conversational behavior (Dittman 1972). The use of gestures, gaze behaviors and body language, remained unrecorded as indicators of conversational intentions.

The experiment was designed to prompt the generalization of trained stimuli to untrained items by pairing the semantic features of the stimuli. The addition of unmatched untrained items would have further explored the impact of the modeling procedure. It is important to determine if a child is able to maintain dialogue about familiar but unrelated items. In doing so, the clinician will better understand if the child is establishing the essential postulates of conversation.

Learning more about the conversational skills of normal children will enable the teacher to develop a range of response modes for language disordered children. Children who rely upon restricted content (such as Contingent responses) become stereotyped in their

conversational roles. Our target with the language impaired child is to establish a repetoire of varied behaviors appropriate to the child's needs, competencies and the context of the situation.

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Appendix
Language Content

Trained Stimuli	Untrained Stimuli
Cookie	Candy
What's this?	What's This?
Cookie	Label
Tastes good	Tastes good
Like to eat with soda	Like to eat
Like to eat after supper	Eat after lunch
Buy in store	Buy in store
Airplane	Car
What's this?	What's this?
Airplane	Label
Goes fast	Goes fast
Goes up in the sky	Goes on the street
People ride in airplanes	People ride in cars
Play with airplane at home	Play with car at home
Glove	Hat
What's this?	What's this?
Glove	Label
Feels soft	Feels soft
Put on hands	Put on head
Keep hands warm	Keeps head warm
Keep in my coat pocket	Keep in drawer at home
Pencil	Crayon
What's this?	What's this?
Pencil	Label
It's long	It's long
Has a point	Has a point
Write with it	Draw with it
Have pencil at home	Have crayon at home
Cat	Dog
What's this?	What's this?
Cat	Label
Has four legs	Has four legs
Says "meow"	Says "woof-woof"
Plays with boys and girls	Plays with boys and girls
Have a cat at home	Don't have a dog at home

Comparing imitation and comprehension training in two language impaired children

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Abstract

This study compared the efficacy of imitation versus comprehension procedures in training the production of the three plural morphemes /s/, /z/, and /ɪz/. Two language impaired children matched on Mean Length of Utterance were trained using two equivalent procedures, one via imitation and one via comprehension. The present research also investigated the effects of imitation versus comprehension training on a variety of linguistic performances. Post-training generalization tasks were administered to assess generalization of the trained morphemes. The results suggested that training via comprehension best facilitated production of the three plural morphemes. The results also indicated that the subjects' performances on the post-training imitation and comprehension tasks were the same regardless of the training procedure employed.

The role of imitation versus comprehension in the acquisition of language has been the focus of research and controversy. Allport (1924) was among the earliest to theorize that language may be acquired through the process of imitation; his underlying assumption was that in order to learn language a child had to repeat the speech he heard around him. Some researchers and theorists such as Mowrer (1960) and Staats (1971) have reported that new language behaviors must be imitated before they can become part of the already existing language behaviors of a child.

Other researchers such as Slobin (1968) and McNeill (1970) contend that if one looks at language from the viewpoint of Chomsky's theory of generative grammar, it is not the overt "surface" structure of an utterance which carries the information relevant to a child's acquisition of linguistic structures, but rather the underlying "deep" structure or transformational form which cannot be imitated. According to this theory, children have to acquire deep structures and transformational rules of sentences, neither of which are recoverable from the surface forms upon which their imitations are based.

The extent and function of children's imitations in the early syntactic period of language acquisition was investigated by Ramer (1975). The results of her study corresponded to those obtained in a similar study by Bloom, Hood, and Lightbown (1974). These studies found that children differed in the degree to which they used imitation in early language development. Although imitation appeared to be a characteristic of early language behaviors and active processing of language, it was not a necessary prerequisite in order to process

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language. In addition, the studies found that as the amount of imitation increased, the ways in which it functioned for the child were different than for children who imitated less frequently. Although the rate of language acquisition was not related to the amount of imitation, an imitation strategy appeared to be an option some children employed in their acquisition of language. Further, the imitation strategy was used only with regard to linguistic forms about to be acquired in spontaneous productions. "Thus, imitation may not be a means of learning, but a means of practicing what has already been learned." (Ramer, p.713).

A number of studies have been conducted with regard to the relationships between imitation, comprehension, and production. Fraser, Bellugi, and Brown (1963) found that in the acquisition of language, imitation preceded comprehension and comprehension preceded production. When a child repeats an adult utterance, there is no way of knowing whether such an utterance is simply the result of rote repetition or whether the child has syntactically reprocessed the adult utterance and reproduced it in this manner. When Fernald (1972) reanalyzed the data of Fraser, Bellugi, and Brown (1963) study, he found that children were able to comprehend sentences that they could not produce correctly. When Fernald (1972) reduplicated the study, revising the tasks, the results revealed no significant differences between comprehension and production.

The value of the use of imitation to facilitate language acquisition has been investigated by many researchers. Clark (1977) reports that although language is considered to be a rule-governed behavior, imitation may aid the child in the discovery of these rules. She believed that a child did not learn novel structures through imitation, nor did the fact that he imitated mean that he was able to comprehend. Shipley, Smith and Gleitman (1969) found that children were able to imitate nonsense material which could not be comprehended. The use of imitation then, could serve to improve a child's linguistic competence rather than teach him novel linguistic structures. Imitation may be viewed as a form of overt rehearsal that the child engages in before he can rehearse silently.

Unlike Clark, who believed that a child could not acquire novel linguistic structures through imitation, the behaviorists felt that children could learn and generalize novel linguistic rules by modeling an adult's language behavior. Gray and Ryan (1973) constructed a training program for language impaired children which was based to a large extent on imitation procedures.

Several researchers have investigated the effects of comprehension training alone on production. These studies have been conducted with college-aged students learning a second language, therefore the subjects were different from those used in the other language acquisition studies cited previously. Asher (1972) for example, found that comprehension training alone did result in production. His data also appeared to indicate that a training procedure which was conducted via comprehension was superior to those training procedures which directly trained

production (e.g. imitation procedures).

There have been studies which explored the effects of imitation versus comprehension training on a variety of linguistic performances. Ruder, Smith and Hermann (1974) investigated whether comprehension training in itself was sufficient to achieve untrained verbal production. Their study also examined whether comprehension training would be more successful than a procedure which included imitation as well. The data obtained from their study indicated that for production of a lexical item training was needed in both the areas of imitation and comprehension. Hoffman and Wollner (1977) investigated the effects of training through imitation and comprehension procedures. Their results indicated that training through the use of an imitation procedure had no effect on comprehension, production, grammaticality judgment, and grammaticality correction; while training through the use of a comprehension procedure led to improved performance in all of these areas.

The purpose of the present study was to explore the efficacy of an imitation versus a comprehension procedure on the production of a linguistic structure in two language impaired children. The study also examined the effect the different training procedures had on the subject's linguistic performances.

Method

Subjects:

Subject 1, F., was a 13 year old Down's Syndrome male who attended therapy at the Queens College Speech and Hearing Center. F was enrolled in a CRMD class for the trainable retarded in the Public School system. Developmental milestones were generally delayed, consistent with the diagnosis of mental retardation. F's mother did not recall the age at which he began to speak, however, she reported that F inconsistently produced two-word utterances at the age of six years. The Peabody Picture Vocabulary Test (PPVT) revealed a score which was equivalent to the first percentile for his chronological age. The Carrow Test for the Auditory Comprehension of Language (TACL) revealed an age equivalency score of 3.7 years. However, it was reported by the interviewer that results obtained from formal testing did not adequately reflect F's abilities. A language sample obtained prior to the onset of the present study revealed that F had a Mean Length of Utterance (MLU) of 2.79 and was functioning in the fourth phase of language development (Bloom and Lahey, 1978). The Fisher-Logemann Test of Articulation revealed that F's articulation errors were characterized mainly by substitutions. F's intelligibility in spontaneous speech was generally good.

Subject 2, C., was a 5 year old language delayed male who had attended therapy at the Queens College Speech and Hearing Center. C was enrolled in a Public School Readiness program. C's mother reported that he uttered his first words at the age of three years; both Hebrew and English were spoken in the home. All other developmental milestones were reported to be normal. A language sample obtained prior to the initiation of the present study revealed that C had a Mean Length of

Utterance (MLU) of 3.34 and was functioning in the fourth phase of language development (Bloom and Lahey, 1978). The Fisher-Logemann Test of Articulation revealed that the majority of C's articulation errors were substitutions. His intelligibility in conversational speech was generally good.

Apparatus:

The experimental procedure was conducted in a 10' by 15' room at the Queens College Speech and Hearing Center. During the training procedure, the experimenter and the subject were seated next to each other at a small table. One observer was present throughout the experiment to record data. Reinforcers consisted of candy, pretzels, and popcorn, which were placed on the table so that they were always visible to the subjects. In addition, tokens were utilized throughout the procedures and were exchanged for playtime.

Stimulus materials used for the training procedures consisted of 48 colored pictures. Twenty-four pictures depicted singular nouns and twenty-four pictures depicted the plural counterparts of those nouns. (Appendix A). Each of the three morphological endings (/s/, /z/, and /ɪz/) was represented by eight pictures. All of the nouns used in training represented objects which were familiar to the subjects.

Stimulus materials used for the pre and post-training imitation, comprehension I, and production I tasks consisted of 15 real objects, 15 magazine pictures, and 30 sets of colored line drawings which depicted nonsense words (Appendix B). Each picture or object used was presented in both the singular and plural form. In other words, there were duplicates or triplicates of every picture or object used. Each of the three morphological endings was represented by 10 real words and 10 nonsense words in the imitation, comprehension I, and production I tasks. The same 60 words were used in all three tasks for both pre and post-training baselines.

In the post-training comprehension II, production II, grammaticality judgment, and grammaticality correction generalization tasks, toys and real objects were used as stimulus materials. All of the nouns used in the comprehension II task were also used in the production II task. Test sentences for the four generalization tasks are presented in Appendix C.

Procedure:

Performance on seven tasks-imitation, comprehension I, comprehension II, production I, production II, grammaticality judgment, and grammaticality correction - was investigated in this study. One subject was trained via a comprehension procedure, the other via an imitation procedure. Pre and post-training baselines were obtained for the imitation, comprehension I, and production I tasks. Performance

on each of the remaining four tasks (comprehension II, production II, grammaticality judgment, and grammaticality correction) was measured post-training as a test of generalization. Post-training baselines for imitation, comprehension I, and production I tasks were measured using pre-training stimuli.

Pre and post-training imitation was defined as the exact repetition of the plural noun produced by the experimenter, as the experimenter pointed to a corresponding picture or group of objects. During the imitation tasks, the experimenter instructed the subject to "Say what I say." Although the subject was only required to imitate the plural form of a noun, the singular form of that noun was also represented by a picture or an object.

Pre and post-training comprehension I was defined as the ability to demonstrate understanding of the plural marker by pointing to an appropriate picture. For each pair of pictures presented, the discriminative stimulus "Show me_____" was used. The subject was required to point to the picture which he thought was correct. One picture depicted a singular noun, the other depicted the plural form of that noun. The subject was always required to point to the plural noun.

Post-training comprehension II was defined as the ability to demonstrate understanding of the plural marker by manipulation of objects. The subject was required to perform an action specified by the experimenter that involved the manipulation of objects. For example, Experimenter - "Put the boats in the water." This task represented a less structured setting and was conducted while the subject and experimenter were engaged in play or were involved in an activity (e.g. making chocolate pudding).

Pre and post-training production I was defined as the ability to produce the plural marker when presented with objects or pictures. In this task, the discriminative stimulus "Here is a ball. Here is another ball. Now there are two_____." was used. The subject was required to supply the plural form.

Post-training production II was defined as the ability to produce the plural marker while the subject and the experimenter were engaged in a variety of informal play activities. The activities were arranged to provide opportunities for the subject to produce the plural marker. The subject was instructed to "tell what was happening" as the clinician was performing an action. For example, Experimenter (throwing balls), Subject - "You throwing balls." The task was designed to represent a less structured setting than the production I task.

Post-training grammaticality judgment was defined as the ability to judge whether a stimulus word contained in an utterance was syntactically correct or incorrect. The utterance was presented

orally by the experimenter and the subject was instructed to say whether the word he heard was "right" or "wrong." For example, Experimenter (showing subject three boxes) "Box." Subject - "Wrong."

Post-training grammaticality correction was defined as the ability to correct the ungrammatical stimulus word contained in an utterance produced by the experimenter. The subject was instructed to repeat the word if he thought it was "right." If he thought it was wrong, he was to say "wrong" and correct it. For example, Experimenter (pushing two cars along the floor) "I push car." Subject - "Wrong. Cars."

Pre-training baselines for imitation, comprehension I, and production I were obtained for each subject using the sixty stimulus words listed in Appendix B. Each of the three plural markers (/s/, /z/, and /ɪz/) was represented by ten nouns and ten nonsense words. Nonsense words were included in the pre and post-training baselines to account for the possibility that (some) plurals may be learned as fixed forms. The utilization of the plural morpheme for nonsense words demonstrated that the child mastered the morphological rules governing plurals. During the administration of each of the baselines, the subject was given one trial per word (sixty trials in total). All words were presented in the same order for each baseline. The subject was reinforced for all responses, whether correct or incorrect. Five plural forms from the sixty words used in the pre and post-training baselines were also used in training. Pre-training baselines were not obtained for comprehension II, production II, grammaticality judgment, and grammaticality correction since these tasks were exclusively used as a measure of generalization.

Subject 1 was trained via an imitation procedure and Subject 2 was trained via a comprehension procedure. Assignment of a training condition was based upon the subject's previous clinical responses. Aside from the mode of presentation, the training procedures were identical. In each of the training procedures, the subject was trained using forty-eight stimulus cards (24 pairs). Twenty-four pictures depicted a singular object and twenty-four depicted the plural form of that object. All of the plural markers (/s/, /z/, /ɪz/) were equally depicted in the set of stimulus cards with each morphological ending represented by eight pictures. The forty-eight cards were randomized for both order of presentation (singular vs. plural) and placement on the table (left vs. right). Randomization took place each time the complete set of forty-eight cards was presented to the subject. The nature of the training procedure required that the subject be simultaneously presented with pictures depicting both the singular and plural forms of the noun. Regardless of which procedure was used, each subject reached criterion when he was able to score 90% correct for three consecutive sessions. Training was terminated when criterion was achieved.

The comprehension procedure required the subject to point to

the picture depicting the noun form specified by the experimenter. Two contrasting pictures were placed on the table; a singular noun, and a plural form of that noun. With each presentation, the discriminative stimulus "Show me _____." was used. Correct responses were reinforced with social praise and a token exchange system. In addition, the experimenter subsequently pointed to and named each of the pictures, identifying the contrast between pictures by using the quantifiers "one" and "alot of". For example, Experimenter - "This is ball, one ball. These are balls, alot of balls." Training continued until the criterion of 90% correct over three consecutive sessions was achieved.

The imitation procedure required the subject to repeat the noun form produced by the experimenter as the experimenter pointed to the corresponding picture. Two contrasting pictures were placed on the table in front of the subject; one depicting a singular noun, and the plural form of the noun. With each presentation, the discriminative stimulus "Say what I say" was used to obtain a response. The reinforcement schedule and correction procedure was identical to that used in the comprehension procedure. Training continued until the criterion of 90% correct over three consecutive sessions was achieved.

When the criterion of 90% correct over three consecutive sessions was achieved in the training procedure, post-training baselines in imitation, comprehension I, and production I were administered to each of the subjects. The procedure used to obtain the post-training baselines was identical to the pre-training baseline procedure, as was the set of stimuli. In addition, comprehension II, production II, grammaticality judgment, and grammaticality correction tasks were also presented to each subject as a test of generalization to novel stimuli (Appendix C). The nouns used in the generalization tasks had not been previously presented in the experiment.

Results

The criterion of 90 percent correct over three consecutive presentations of the training stimuli was achieved for the imitation procedure with Subject 1 after ten presentations of the stimuli. The percentages of correct responses for Subject 1 during the administration of the pre-training baselines were: imitation - 83 percent, comprehension I - 55 percent, and production I - 0 percent. Following the completion of the imitation training procedure, the percentages of Subject 1's correct responses increased to 97 percent for imitation, 62 percent for comprehension I, and 10 percent for production I.

The criterion of 90 percent correct over three consecutive presentations of the training stimuli was not achieved for the

comprehension procedure with Subject 2. Training was discontinued after ten presentations of the stimuli. The percentages of correct responses for Subject 2 during the administration of the pre-training baselines were: imitation - 93 percent, comprehension I - 45 percent, and production I - 0 percent. Although Subject 2 never reached criterion on the comprehension training procedure, the percentages of his correct responses increased to 98 percent for imitation, 55 percent for comprehension I, and 52 percent for production I during post-training baselines. The percentage of Subject 1's correct responses increased with each presentation of the training stimuli. Subject 2 consistently responded at chance level, never achieving more than 62 percent correct.

Real and nonsense words were utilized for pre and post-training baselines. Subject 1 showed a greater increase in percent correct for real words in all three tasks. Subject 2 showed a greater increase in percent correct for real words only in the production task.

Comparing the results of the imitation and comprehension I pre and post-training baselines, no significant differences were found among the three morphological endings. Differences were noted among the three morphological endings for both subjects in the production I baseline task. Subject 1's correct responses for the pre and post-training production I baselines increased from 0 percent to 10 percent for the /s/ morpheme and 0 percent to 25 percent for the /ɪz/ morpheme. Production of the /z/ morpheme remained at 0 percent. Subject 2's correct responses for the pre and post-training production I baselines increased from 0 percent to 80 percent for the /s/ morpheme, 0 percent to 70 percent for the /z/ morpheme, and 0 percent to 5 percent for the /ɪz/ morpheme.

Four post-training generalization tasks; comprehension II, production II, grammaticality judgment, and grammaticality correction, were administered in addition to the post-training baselines. Both subjects performed significantly better on the production II generalization task than on the production I pre and post-training tasks. The performance of both subjects on the comprehension tasks increased from pre to post-training baselines as discussed earlier. However, performances varied little for both subjects between the post-training baseline task and the post-training generalization task.

Analyzing the results of the grammaticality judgment and correction tasks, it is clear that the subjects' performances improved significantly when quantifiers were utilized. Although only 50 percent of the sentences in the grammaticality judgment task were correct, both subjects judged all of the sentences to be correct when they were presented without quantifiers. The subjects were unable to make grammaticality corrections without quantifiers.

Discussion

The results of the present study indicated that the comprehension training procedure best facilitated production of the plural morpheme.

These results supported the studies conducted by Asher (1972) and Winitz and Reeds (1972), in which the authors concluded that comprehension training alone resulted in production. The results of the present study also indicated that both training procedures were equivalent in terms of the advances made in the imitation and comprehension I post-training tasks. This appears to indicate that performance on these tasks was independent of the type of training procedure employed.

Subject 2 did not reach criterion on the comprehension task, yet his production of the plural morphemes increased from 0 percent to 52 percent, as measured in the pre and post-training production I baselines. This raises the question of why Subject 2 failed to achieve criterion on the comprehension task and still acquired the ability to inconsistently produce the desired morphological endings. This finding contradicted Koziol's (1973) results which indicated that prior to correct production of the plural morpheme, children receptively recognized the singular and plural forms of nouns.

In contrast, Brown (1973) cited an example of children who performed similarly to Subject 2. Brown's subjects failed to achieve consistently correct performance on the comprehension task. However, they were able to produce the plural morphemes in spontaneous speech. This "receptive lag", was not due to a "lack of knowledge of the semantic distinction and of its grammatical expression," since the subjects demonstrated an ability to produce the plural morphemes. Brown suggested that the child's usual method of comprehension might have been "thrown off" if only a single feature of a sentence was changed. Brown's explanation may have accounted for Subject 2's inability to reach criterion on the comprehension task.

During the comprehension procedure, Subject 2 was instructed to point to the picture which depicted the noun form specified by the experimenter. Subject 2 occasionally repeated the noun form aloud after the experimenter had produced it. This behavior was ignored by the experimenter whether the noun form was correctly or incorrectly produced. However, this linguistic behavior may have contributed to the subject learning to produce the plural morpheme. Ashcraft and Kellas (1974) found that a "verbal rehearsal strategy" such as the one described, appeared to be a component part of memory storage and retrieval. It could therefore have functioned as an uncontrolled variable in the comprehension task. A study conducted by Ruder, Hermann and Schiefelbusch (1977) found that "comprehension training accompanied by appropriate verbal rehearsal resulted in verbal production of syntax with language delayed subjects, while comprehension training not accompanied by appropriate verbal rehearsal did not result in stable verbal production performance." (p.70). Future studies should compare the production gains made by a subject trained via a comprehension procedure accompanied by a consistent verbal rehearsal strategy to the production gains made by a subject in which the procedure did not employ a verbal rehearsal strategy.

Cazden (1968) found that a developmental order existed for the acquisition of the production of the plural morphemes in normal language development. The /s/ morpheme develops first in children, followed closely by /z/. The /ɪz/ ending develops last and appears much later. Subject 2 followed the above order of acquisition. However, this order of acquisition was not exhibited by Subject 1 (best performance on /ɪz/ production). The experimenters speculate that the /ɪz/ morpheme may have been the most salient endings for Subject 1 since this morpheme at the end of a noun results in an additional syllable added to the noun form rather than a single phoneme as with /s/ or /z/.

The data obtained from the imitation, comprehension I, and production I pre and post-training baselines can also be examined in terms of real and nonsense words. Subject 1's performance was superior when real words were utilized. Subject 2 performed better when real words were utilized in the comprehension and production tasks, but performed equally well with both real and nonsense words in the imitation task. One explanation for the overall inferior performance with nonsense stimuli is the unfamiliarity of the form.

Both subjects performed better on the production II and comprehension II post-training generalization tasks than on the production I and comprehension I pre and post-training baselines. Production II was a less-structured, play-oriented task as compared to the highly structured and unnatural production I task. The less structured task may have facilitated production of the morphological endings.

The results of the grammaticality judgment and correction tasks have shown that both subjects' performances significantly increased when quantifiers were utilized. The probable explanation for this increase is that both subjects "cued in" to whether the correct quantifier was used rather than the presence or absence of a morphological ending. It is interesting to note that both subjects demonstrated an ability to comprehend and correctly judge the grammaticality of a sentence when the lexical marker for plurality was utilized, but were unable to comprehend and correctly judge the grammaticality of a sentence when the morphological marker for plurality was used. This difference in performance between the ability to comprehend the lexical and morphological markers for plurality should be further investigated in normal and language delayed children.

Several important questions regarding language training procedures remain unanswered. While recent advances have been made in the field of normal language acquisition the need for similar studies with language disordered children is indicated. In addition, practical applications of the theoretical bases of normal language acquisition should be developed for the clinician.

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Appendix A

Training Stimuli*

Singular	Plural /s/
1. pot	1. pots
2. lollipop	2. lollipops
3. kite	3. kites
4. truck	4. trucks
5. rabbit	5. rabbits
6. cat	6. cats
7. fork	7. forks
8. clock	8. clocks

Singular	Plural /z/
1. tree	1. trees
2. bird	2. birds
3. umbrella	3. umbrellas
4. comb	4. combs
5. chair	5. chairs
6. hand	6. hands
7. spoon	7. spoons
8. ball	8. balls

Singular	Plural /ɪz/
1. witch	1. witches
2. dress	2. dresses
3. orange	3. oranges
4. house	4. houses
5. bridge	5. bridges
6. face	6. faces
7. nurse	7. nurses
8. toothbrush	8. toothbrushes

*training stimuli were used in both the imitation and comprehension training procedures.

Appendix B

Pre and Post-training Stimuli*

Real Words	Nonsense Words
/s/	
1. boats	1. flɛps
2. cups	2. pɪps
3. plates	3. blups
4. cats +	4. druks
5. blocks	5. krɛts
6. hats	6. ʌmpɹ̈ts
7. socks	7. mɪps
8. cakes	8. nuts
9. shirts	9. bulɹ̈ps
10. books	10. zlɪps
/z/	
1. dogs	1. wʌgz
2. pens	2. nɪnz
3. boys	3. druz
4. girls	4. lʌbz
5. combs +	5. pliz
6. cars	6. mɻ̈dz
7. pegs	7. uluz
8. crayons	8. mɪdz
9. flowers	9. wɻ̈mz
10. apples	10. jeɪŋʌz
/ɪz/	
1. houses +	1. trɻ̈sɪz
2. glasses	2. flɛtʃɪz
3. horses	3. puzɪz
4. boxes	4. blizɪz
5. watches	5. suksɪz
6. matches	6. mɻ̈tʃɪz
7. buses	7. krutʃɪz
8. faces +	8. vuzɪz
9. dresses +	9. rɻ̈tʃɪz
10. sandwiches	10. pluwɪtʃɪz

* Stimuli were used for imitation, comprehension I, and production I tasks.

\+ Stimuli also used in the training procedure.

Appendix C

Post-training generalization tasks

Comprehension II (what subjects were asked to do)

Activity I

1. Gimme house.
   Put houses on floor.

2. Gimme girl.
   Put girls by house.

3. Put beds by tree.
   Put bed in box.

4. Gimme chair.
   Put chairs by house.

5. Put boys on floor.
   Put boy by house.

6. Give Fran hat.
   Take hats out of box.

7. Gimme shirts.
   Put shirt in box.

8. Show Fran dresses.
   Gimme dress.

9. Gimme pails.
   Put pail by tree.

10. Put shovel on table.
    Gimme shovels.

11. Put buses on floor.
    Put bus on table.

12. Gimme shoelaces.
    Put shoelace on tree.

13. Put truck by fence.
    Give Fran trucks.

14. Put pot on table.
    Put pots in bus.

15. Gimme boxes.
    Put box on table.

16. Show Fran suitcases.
    Put suitcase in bus.

17. Put horse by tree.
Put horses in barn.

18. Give Fran boats.
Put boat in water.

19. Put witch in boat.
Gimme witches.

20. Throw rock at witch.
Gimme rocks.

Activity 2

1. Gimme dish in bag.
Show Fran dishes.

2. Give Fran potato chips.
Gimme potato chip.

3. Put pretzel in bag.
Give Fran pretzels.

4 Gimme napkin.
Give Fran napkins.

5. Gimme balloons.
Put ballon on wall.

6. Take cups out of bag.
Put cup on table.

7. Put cookie on plate.
Gimme cookies.

8. Give Fran cupcakes.
Put cupcake on table.

9. Gimme lollipop.
Put lollipops in bag.

10. Give Fran matches.
Put match in bag.

Production II (what experimenter was doing)

Activity I

1. Giving Fran houses.
Putting house on floor.

2. Putting beds in house.
Putting bed in box.

3. Putting chair on table.
   Putting chairs by tree.

4. Putting girls in house.
   Putting girl by tree.

5. Giving boy to Fran.
   Putting boys by truck.

6. Putting hats on floor.
   Putting hat on table.

7. Putting dress in box.
   Putting dresses in suitcase.

8. Giving Fran shirts.
   Putting shirt on table.

9. Putting pails by tree.
   Putting pail by table.

10. Putting shovel in house.
    Putting shovels by fence.

11. Giving Fran buses.
    Putting bus on floor.

12. Putting shoelace on horse.
    Putting shoelaces in box.

13. Putting trucks by fence.
    Putting truck under table.

14. Putting pots in house.
    Putting pot on table.

15. Putting boxes in truck.
    Putting box in house.

16. Putting suitcase in truck.
    Putting suitcases on floor.

17. Putting horses by tree.
    Putting horse in barn.

18. Giving Fran boat.
    Putting boats in water.

19. Putting witches in boat.
    Putting witch on table.

20. Throwing rocks.
    Putting rock in water.

Activity 2

1. Putting dishes on table.
   Putting dish in bag.

2. Eating potato chips.
   Giving subject potato chip.

3. Putting pretzel on table.
   Putting pretzels on dish.

4. Putting napkins in bag.
   Putting napkin on table.

5. Giving Fran balloon.
   Putting balloons on wall.

6. Getting cup from bag.
   Giving Fran cups.

7. Putting cookies on plate.
   Putting cookie on table.

8. Putting cupcake in bag.
   Giving Fran cupcakes.

9. Putting lollipops on table.
   Putting lollipop in bag.

10. Giving Fran matches.
    Putting match on table.

Grammaticality Judgment and Correction

/s/ morpheme

1. I putting stamps on letter. (W)*
2. I reading book. (R)*
3. I putting candy in baskets. (R)
4. I putting cupcake in bag. (W)
5. I holding snake. (W)
6. I eating carrot. (R)
7. I wearing socks. (W)
8. I putting fork on table. (R)
9. Girl wearing boots. (R)
10. I playing with puppets. (W)

/z/ morpheme

1. I pushing cars. (W)
2. I washing bottles. (R)
3. I reading newspaper. (R)
4. I sewing buttons. (W)

5. I throwing ball. (R)
6. I have tissues. (R)
7. I picking up pin. (W)
8. I smelling flower. (W)
9. I looking at pictures. (R)
10. I lighting candle. (W)

/ɪz/ morpheme

1. I blowing noses. (W)
2. I tying shoelace. (R)
3. I making face. (W)
4. I giving doll kisses. (R)
5. I wiping glass. (R)
6. I wearing watches. (W)
7. I pushing bus. (R)
8. I putting oranges on table. (W)
9. Girl wearing dresses. (W)
10. I putting box on floor. (R)

*Note: (W) grammatically incorrect.

(R) grammatically correct.